

An Investigation into the Effectiveness of School-based Physical Activity Interventions for Adolescent Girls

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Abstract

Background

Regular engagement in physical activity (PA) provides children and young people with numerous physical, psychological and social health benefits. PA levels decline during adolescence and girls are less active than boys. Schools have been suggested as a promising location to target adolescent girls' PA behaviours. Recently, numerous researchers have incorporated peer-led approaches into PA intervention designs. However, little is known about the feasibility, acceptability and effectiveness of these approaches. The overarching aims of the research programme were to investigate the effectiveness of school-based PA interventions for adolescent girls and assess the feasibility, acceptability and effectiveness of a novel school-based peer-led PA intervention to improve the PA levels and reduce the sedentary time (ST) of adolescent girls.

Methods

This programme of work included four studies. Study 1 was a systematic review and meta-analysis of the literature to assess the effectiveness of previous school-based interventions for adolescent girls. Study 2 was an exploration study, which assessed girls' thoughts and perceptions of current school PA practices. Study 3 incorporated the design of a novel three-tier peer-led school PA intervention, with a mentoring component, as part of the Girls' Peer Activity (G-PACT) project. University students (Mentors) delivered a series of leadership and PA educational sessions to a group of adolescent PA Leaders who disseminated this information to their Peers and encouraged them to engage in more PA. The G-PACT intervention was underpinned

by Social Cognitive Theory and Self-Determination Theory. This study evaluated the effectiveness of the G-PACT intervention on adolescent girls' PA levels and ST. Study 4 was a feasibility and acceptability assessment of the G-PACT intervention in the secondary school setting utilising a qualitative approach.

Results

Study 1 established that school-based interventions for adolescent girls have a small but positive impact on girls' PA levels. Interventions underpinned by theory and multi-component in nature were more effective. Study 2 provided an insight into girls' school PA experiences, highlighting their enjoyment of PA with friends and the importance of choice over activities. Study 3 demonstrated that the G-PACT intervention with a fitness class-based after-school club was effective increasing girls' PA levels. Study 4 indicated that the link between Mentors and Leaders in the G-PACT intervention was feasible and acceptable. However, the link between Leaders and their Peers requires refinement to improve the communication processes.

Conclusion

Schools are a promising setting to promote PA among this population, but past interventions only have a small positive impact on girls' PA levels. Engaging with adolescent girls and listening to their needs is crucial to inform the development of complex interventions in a school setting. Novel interventions such as the G-PACT intervention should be encouraged as they show promise in increasing adolescent girls' PA levels, and this innovative intervention approach warrants piloting before consideration on a larger scale.

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List of Abbreviations

APHV	Predicted Age at Peak Height Velocity
BMI	Body Mass Index
BTM	Born to Move
CONSORT	Consolidated Standards of Reporting Trials
cRCT	Cluster randomised control trial
CSPAP	Comprehensive School Physical Activity Programming
ENMO	Euclidean Norm Minus One
GMT	Greenwich Mean Time
G-PACT	G irls P eer A ctivity
HA	High active
HR	Heart rate
ICAD	International Children's Accelerometry Database
IMD	Indices of Multiple Deprivation
LMA	Low-to-mid active
LPA	Light physical activity
MET	Metabolic equivalent
MPA	Moderate intensity physical activity
MRC	Medical Research Council
MVPA	Moderate-to-vigorous physical activity
NCDs	Non-communicable diseases
PA	Physical activity
PE	Physical education

PRISMA	Preferred Reporting Items for Systematic Reviews & Meta-Analyses
RCT	Randomised controlled trials (RCTs)
SB	Sedentary behaviour
SCT	Social Cognitive Theory
SD	Standard deviation
SDT	Self-determination Theory
SE	Self-efficacy
SE	Standard error.
ST	Sedentary time
SVM	Signal Vector Magnitude
TA	Thematic analysis
TEO	Theory of Expanded, Extended, and Enhanced Opportunities
TPB	Theory of Planned Behaviour
TV	Television
VPA	Vigorous intensity physical activity
WHtR	Waist circumference-to-height ratio
YAP	Youth Activity Profile

Chapter 1

Introduction

1.1. The Research Problem

Physical Activity (PA) is defined as any bodily movement produced by skeletal muscles that requires energy expenditure (Caspersen, Powell, & Christenson, 1985). Regular moderate intensity PA (MPA), such as brisk walking, gardening, swimming or participating in sports, that noticeably accelerates the heart rate, has significant benefits for health (World Health Organisation, 2010). The World Health Organisation (World Health Organisation, 2014) has classified physical inactivity as the fourth leading risk factor for global mortality from non-communicable diseases (NCDs). Among adults, low levels of PA are associated with higher levels of obesity, hypertension, type 2 diabetes and cardiovascular risk factors (Lee et al., 2012). Thus, physical inactivity has a major health impact on population health (Lee et al., 2012) and immediate action is required to increase PA levels and improve population health (Kohl III et al., 2012).

Regular engagement in PA is associated with numerous health benefits for children and young people aged 5-18 years (Janssen & Leblanc, 2010; Poitras et al., 2016). This includes reduced body fat and the promotion of healthy weight, enhanced cardio-metabolic and bone health, and enhanced psychological well-being (Ahn & Fedewa, 2011; Janssen & Leblanc, 2010; Poitras et al., 2016; Ramires et al., 2016). It is recommended that children and young people engage in 60 minutes of moderate to vigorous PA (MVPA) per day (Chief Medical Officers, 2011). Children and young people should also incorporate weight-bearing exercise on at least three days per week and reduce sedentary time (ST) (Chief Medical Officers, 2011).

Sedentary behaviour (SB) is a prevalent issue closely linked to children's health status, SB is widely regarded as any waking activity which is categorised with an energy expenditure ≤ 1.5 metabolic equivalents and a sitting or reclining posture (Tremblay et al., 2017). Therefore, SB is not just a lack of PA, it involves time spent engaging in sedentary pursuits. Often in children and young people, these postures include the engagement in screen-based media such as television (TV) viewing or mobile phone usage (Carson et al., 2016). Higher durations/frequencies of screen time and TV viewing were associated with unfavourable body composition, higher clustered cardiometabolic risk scores and unfavourable behavioural conduct/pro-social behaviour (Carson et al., 2016).

MVPA is consistently associated with fitness in youth (Júdice et al., 2017), and should be the primary target of public health recommendations, but breaking up long periods of ST should also be strongly considered (Júdice et al., 2017). The International Children's Accelerometry Database (ICAD) which consists of objectively measured accelerometry data from multiple continents suggests that among 5-17 year olds, only 9% of boys and 1.9% of girls achieved the recommended 60 minutes of MVPA (Cooper et al., 2015). Boys were more active than girls, and both boys' and girls' activity levels declined through adolescence (Cooper et al., 2015).

In the UK, PA levels have been found to start declining from the age of 7, for both boys and girls (Farooq et al., 2017). Once entering secondary school at 11 years old in England girls' PA levels decline at a steeper and faster rate to boys (Public Health England, 2016). This decline of PA during adolescence is a consistent finding in the literature (Dumith, Gigante, Domingues, & Kohl III, 2011). Furthermore, findings

suggest that physically active adolescents are more likely to become active adults (Sun et al., 2016). However, girls are less likely to maintain sufficient levels of PA through adolescence, than their male counterparts (Brown, Corder, Atkin, & van Sluijs, 2017).

PA enjoyment (i.e., positive feelings toward PA) is a determinant of PA among girls during adolescence and sustained PA throughout adulthood (Budd et al., 2018). Thus, it is recommended that interventions target PA enjoyment to increase PA levels in this population (Budd et al., 2018). Previous school-based interventions for adolescent girls however have been found to be largely ineffective at increasing MVPA (Camacho-Minano, LaVoi, & Barr-Anderson, 2011; Pearson, Braithwaite, & Biddle, 2015). Interventions showing promise were underpinned by behaviour change theory, were multicomponent in nature, and were school-based (Pearson et al., 2015). However, prior to the current research programme, the effectiveness of school-based PA interventions for adolescent girls have not been systematically evaluated (Owen, Curry, Kerner, Newson, & Fairclough, 2017).

There have been calls by experts in the field to find new ways to help and support adolescent girls to be physically active through identifying ways to support and encourage sustained engagement in PA over the life course (Jago et al., 2015). The use of peer strategies have shown promising evidence to be effective with adolescent girls (Camacho-Minano et al., 2011) and social support from peers is a consistent correlate of youth PA (Ommundsen, Klasson-Heggebø, & Anderssen, 2006). Peer social support exerts a strong influence on adolescent MVPA (Beets, Cardinal, & Alderman, 2010; Silva, Lott, Mota, & Welk, 2014). For 11-14 year old girls, higher MVPA is positively

associated with higher social support from friends (Young, Saksvig, Wu, Zook, Li, et al., 2014).

Additionally, girls who frequently take part in PA with their best friend, obtain higher levels of PA (Jago et al., 2011). The findings suggest that future interventions should utilise different friendship groups as an effective way to promote increased PA in youth (Jago et al., 2009). Peer-delivered PA interventions are often an overlooked opportunity for PA promotion with youths (Ginis, Nigg, & Smith, 2013). However, there has recently been an increased interest and subsequent funding dedicated to investigate the impact of peer-led approaches to increase adolescent girls PA levels (Corder, Brown, Schiff, & van Sluijs, 2016; Harrington et al., 2018; Sebire, Edwards, Campbell, et al., 2016). Peer-led approaches involve similar aged peers (Jenkinson, Naughton, & Benson, 2012), interacting with and motivating their friends to initiate, continue and sustain positive behaviours (Barr-Anderson et al., 2012; Campbell et al., 2008). These approaches have shown initial promise (Corder, Brown, et al., 2016; Harrington et al., 2018), but have shown no long-term change in PA levels at follow up (Harrington et al., 2018). Research projects may require further upscaling to assess their true impact (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Sebire, Edwards, Campbell, et al., 2016).

Similarly, interventions promoting PA in the school environment delivered by older mentors or role models have been suggested as more appealing to adolescents than interventions delivered by teachers or researchers (Corder, Brown, et al., 2016). Cross-age mentorship interventions have previously improved adolescent health behaviours, such as nutrition (Black et al., 2010), smoking cessation (Campbell et al.,

2008), and sexual health (Davey-Rothwell, Tobin, Yang, Sun, & Latkin, 2011). However, cross-age mentorship has been understudied in PA research with young people (Ginis et al., 2013; Smith, 2011). During adolescence, social priorities develop, academic demand increases and many biological and physiological changes occur (Viner et al., 2012). Peer-led learning in combination with cross-age mentoring could be of benefit to adolescent girls, providing role models and guidance to support their PA behaviours. The peer-led approach also provides another option for girls who may not be attracted to the sometimes competitive, rigorous, and potentially uncomfortable nature of traditional school-based PA (Jenkinson et al., 2012).

1.2. Theoretical Framework

1.2.1. Socio-ecological Model of Health Behaviour

Human behaviour is complex. Behaviour change is challenging to achieve and difficult to maintain. PA interventions should utilise appropriate conceptual health promotion models to identify and prioritise key behavioural constructs of the target population (Abraham, Kelly, West, & Michie, 2009; Abraham & Michie, 2008). Successful interventions with youth populations have been centred on a socio-ecological model encompassing multilevel factors (McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis, Owen, & Fisher, 2015). The core concept of an ecological model is that a selected behaviour has multiple levels of influence. The advantage of using such a model is that it provides comprehensive frameworks for understanding multiple and interacting elements of health behaviours such as PA. Critically, socio-ecological models can be

utilised to develop comprehensive intervention approaches that identify and target mechanisms of change at each level of influence (Sallis et al., 2015).

The socio-ecological model of health behaviour is based around four key principles (Sallis et al., 2015). Firstly, there are multiple influences on health behaviour including intrapersonal (biological, psychological), interpersonal (social, cultural), institutional, community, environmental and public policy. These may directly or indirectly impact youths' PA levels. Secondly, influences on behaviour interact across different levels of the model. Third, the socio-ecological model should be behaviour specific and identify the most relevant and prominent influences at each level, in addition to identifying any potential future influences. Finally, the model postulates that multi-level interventions should be most effective in changing behaviour. According to the model, behaviour change is expected to be most successful when all aspects of the model are interacting effectively; when environments and policies support healthful choices, when social support and social norms for healthful choices are strong, and when individuals are educated and motivated to make those choices (Sallis et al., 2015).

1.2.2. Social Cognitive Theory (SCT)

The SCT is based on the concept that human behaviour is a triadic, dynamic, and reciprocal interaction of personal factors, behaviour, and the social environment (Bandura, 1986). The theory takes into account a person's past experiences, which shape whether a person will engage in a specific behaviour and the reasons why a person engages in that behaviour. The theory uniquely considers the way in which individuals acquire and maintain behaviour, generally through observing and imitating others, while also considering the social environment in which individuals perform the

behaviour. According to the SCT self-efficacy (SE) is the central determinant to behaviour (Bandura, 1986, 1997, 1998). This construct impacts behaviour both directly and indirectly through personal factors and the environment. SE can be defined as the confidence in one's own ability to complete tasks and reach goals (Bandura, 1986, 1997).

SE is influenced and formed through multiple sources, such as past performance, vicarious experiences, verbal persuasion, and physiological cues (Bandura, 1986, 1997). Past performance experiences is the biggest contributing factor influencing one's level of SE to complete a given task (Bandura, 1986, 1997). Vicarious experiences is defined as watching others similar to oneself succeed and learning from their experience. Verbal persuasion related to one's belief that they have what it takes to succeed, which can be influenced by feedback from others. Finally, physiological cues or affective states, such as stress or negative emotions, influence one's ability to complete the given task (Bandura, 1997).

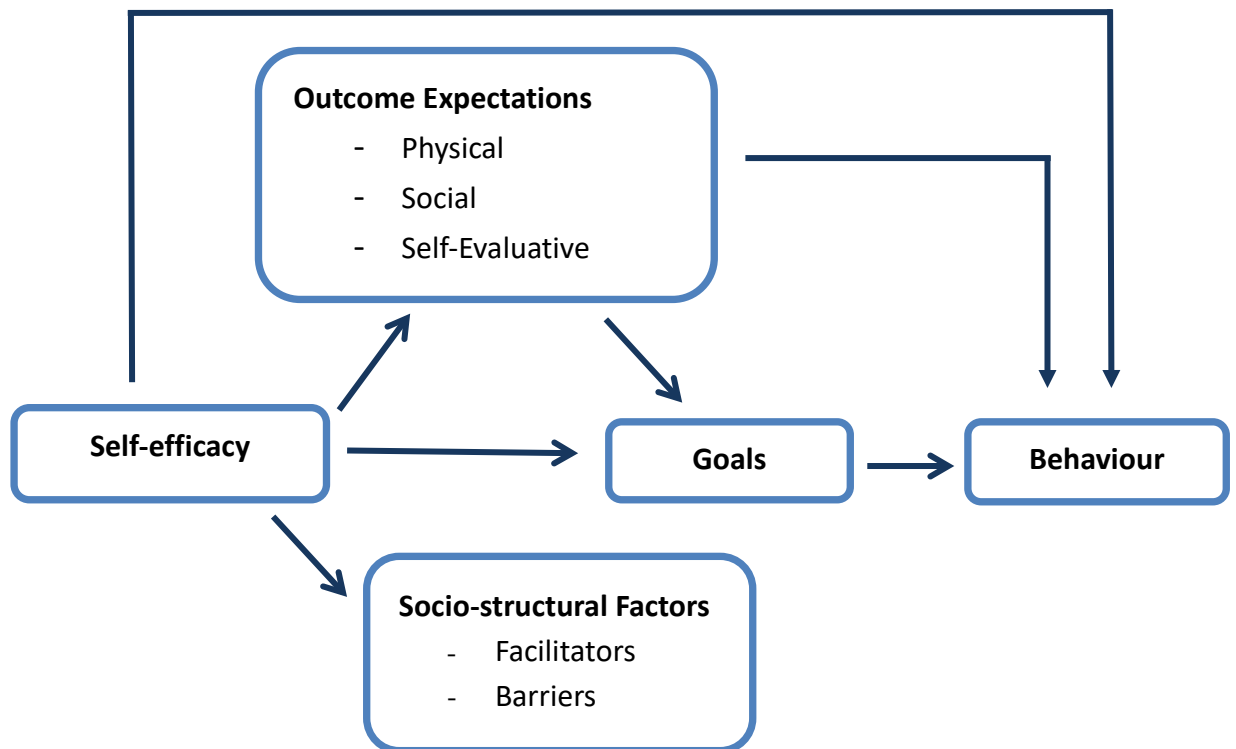


Figure 1.1. Bandura's (1998) Self-efficacy determinants embedded in the causal structure of the SCT.

As seen in Figure 1.3. SE directly influences outcome expectations, socio-structural factors, goals or intended goals and actual behaviour (Bandura, 1998). In relation to PA, SE can influence health behaviours indirectly through influencing each of these factors. An individual with low levels of PA SE would be more likely to; (1) not perceive PA as personally beneficial, (2) perceive more social and environmental barriers to PA engagement, (3) be less likely to have goals or plan goals supporting regular PA engagement, and (4) have low levels of PA (Bandura, 1997, 2004). SE has been consistently correlated with PA engagement across multiple age groups (Bauman et al., 2012). PA interventions with adolescents have been shown to lead to improvements in SE (Cataldo, John, Chandran, Pati, & Shroyer, 2013). Additionally, there is strong support for SE as a mediator of PA in theory based interventions (Lubans, Foster, & Biddle, 2008).

1.2.3. Self-determination Theory (SDT)

The SDT (Ryan & Deci, 2000) has been often applied to understand PA participation. The SDT is based upon the notion that motivation is influenced by social factors through the satisfaction of three basic psychological needs: autonomy (control, choice), relatedness (closeness to peers) and competence (perceived ability to complete task) (Figure 1.1.).

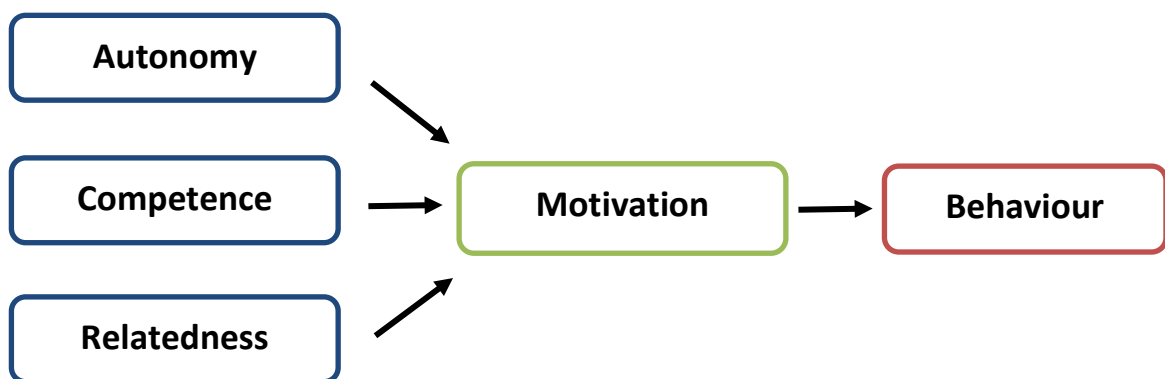


Figure 1.2. Deci and Ryan's (2000) Self-determination theory three basic psychological needs model.

The theory proposes that motivations underlying human behaviour can be placed on a continuum from low to high levels of self-determination: intrinsic motivation, integrated, identified, introjected, external regulation, and amotivation (Labbrozzi, Robazza, Bertollo, Bucci, & Bortoli, 2013) (Figure 1.2.). Intrinsically motivated behaviours, those which are engaged in for feelings of fun, pleasure, satisfaction and no discernible reward or reinforcement, are experienced as more rewarding by individuals since they foster the sense of autonomy, relatedness and competence (Labbrozzi et al., 2013).



Figure 1.3. Deci and Ryan's (2000) Self-determination theory continuum.

As seen in Figure 1.2, introjected regulation and identified regulation are situated towards the intrinsic (self-determined) side of the continuum. Introjected regulation, closest to intrinsic motivation, relates to behaviours that are important to the individual and contribute to the sense of self. Identified regulation is closer to the middle of the continuum. Behaviours in this component relate to personally held values, such as learning new skills or self-betterment. Although these two components are classified as extrinsic forms of motivation, they are more closely related to intrinsic motivation than the two traditional forms of extrinsic motivation, introjected regulation (maintain self-esteem or avoid guilt) and external regulation (rewards or avoiding punishment). Amotivation, located to the right of the figure, is defined as lack of or no motivation (Ryan & Deci, 2000).

In relation to PA, the development of intrinsic motivation is the focus of many interventions (Dishman, McIver, Dowda, Saunders, & Pate, 2015; Owen, Smith, Lubans, Ng, & Lonsdale, 2014; Weiss, 2000). Intrinsic motivation is a key component of a motivational profile and has been systematically associated with the actual PA levels in adolescence (Taylor, Ntoumanis, Standage, & Spray, 2010). However, integrated and identified regulation also contribute towards feelings of autonomy over PA behaviours (Dishman et al., 2015).

1.2.4. Integration of Theory

Socio-ecological model (McLeroy et al., 1988; Sallis et al., 2015) provides an overview of the multiple sources of influences on adolescent girls PA behaviours. This encompasses the interaction between each level of the model from public policy to intrapersonal factors. Moreover, the SCT provides a structure to understand behaviour based on personal, behavioural and environmental factors (Bandura, 1986, 1997, 1998). The SCT factors interact simultaneously but does not provide an understanding of why girls engage in certain behaviours. The SDT can be used to better understand girls' motivation (Ryan & Deci, 2000), is provides an understanding of why people engage in behaviours and what motivates them to behave that way. The SDT also provides an insight into the different forms of motivation and how they are formed through psychological needs satisfaction. When combined together, the socio-ecological model, SCT and SDT provide a complimentary structure to understand girls PA behaviours.

1.3. Aims and Objectives

Aim of the investigation:

The overarching aim of the research programme was to evaluate the effectiveness of school-based PA interventions for adolescent girls. This included the development of a novel school-based PA intervention to increase the PA levels and reduce ST of adolescent girls, and an assessment of the intervention's feasibility, acceptability, and effectiveness.

Research Questions:

1. What are the current PA and ST patterns of adolescent girls?
2. Are previous school-based PA interventions for adolescent girls effective in increasing PA levels?
3. Is a peer-led mentoring model with educational and PA components feasible and acceptable in the secondary school setting?
4. Is a peer-led mentoring model feasible in communicating PA messages with adolescent girls?
5. Can a peer-mentoring model be effective in increasing adolescent girls' PA levels?

1.4. Thesis Structure

The Behavioural Epidemiology Framework (Sallis, Owen, & Fotheringham, 2000) has been used as an organising framework in Chapter 2, which establishes links between PA and health, summarises methods of PA measurement, identifies influences on PA, evaluates previous interventions to change PA, and links behaviour change theory into practice. Chapter 2 provides an extensive literature review in relation to youth PA and school-based PA interventions. The review critiques the current literature and highlights a rationale for the programme of research.

Chapter 3 presents a systematic review and meta-analysis on the effectiveness of school-based interventions for adolescent girls. Summarising the effectiveness of previous interventions and highlighting important components contributing to intervention success.

Chapter 4 presents an exploratory investigation into adolescent girls' thoughts and perceptions of school PA provision. This chapter illustrates the formative work conducted to inform development of the Girls Peer Activity (G-PACT) project.

Chapter 5 presents the development and design, of a novel school peer-led mentoring model to be used as the main intervention component for the G-PACT project. This chapter demonstrates the impact of the G-PACT project intervention on the PA levels and ST of adolescent girls.

Chapter 6 presents the main findings of the G-PACT project, the feasibility and acceptability of the intervention in secondary school settings. The qualitative findings highlight key aspects influencing the implementation of the intervention in the school setting, and whether the intervention was feasible and acceptable to adolescent girls.

Chapter 7 provides a synthesis of findings from the programme of research and provides recommendations for future practice and research.

1.5. Original Contribution to Knowledge

This research project was the first to systematically analyse the effectiveness of school-based interventions for adolescent girls. The G-PACT project incorporated a formative assessment in the current environment, which informed the design, implementation and evaluation of a novel school peer-led PA intervention with adolescent girls in the West Lancashire region of England. This school peer-led PA intervention aimed to encourage greater engagement and enjoyment of PA for adolescent girls. This project was the first in the UK to utilise a three-tier peer-led

mentoring model of delivery, which incorporated the novel use of undergraduate students as cross-age mentors and role models for adolescent girls, in addition to a peer-led approach.

Chapter 2

Literature Review

2.1. Benefits of Regular PA

Regular PA is associated with numerous health benefits for children and young people aged 5-18 years (Chief Medical Officers, 2011; Janssen & Leblanc, 2010). These health benefits include reduced body fat and the promotion of healthy weight, enhanced cardio-metabolic and bone health, and enhanced psychological well-being (Biddle & Asare, 2011; Janssen & Leblanc, 2010; Ramires et al., 2016). Research indicates that regular PA can reduce the short term effects of depression and anxiety and increase self-esteem and enjoyment for children and young people (Ahn & Fedewa, 2011; Brown, Pearson, Braithwaite, Brown, & Biddle, 2013; Lubans et al., 2016; Whitelaw, Teuton, Swift, & Scobie, 2010).

PA not only has a significant positive impact on youth's cognitive outcomes but it also associated with increased academic achievement (Donnelly et al., 2016; Fedewa & Ahn, 2011). Adolescents who are moderately active and maintain activity levels over a prolonged period of time tend to show higher cognitive performance (Esteban-Cornejo et al., 2015). Therefore, it is vitally important that children and young people engage in regular PA to protect against negative health outcomes and increase the positive effect of physical and psychological outcomes, both in the short and long term.

In order to improve cardiorespiratory and muscular fitness, bone health, and cardiovascular and metabolic health markers it is recommend that all children and young people (5-18 years) should engage in moderate to vigorous PA (MVPA) for at least 60 minutes every day (Chief Medical Officers, 2011; World Health Organisation, 2010). Moderate intensity PA requires a moderate amount of effort and noticeably

accelerates the heart rate, for example a brisk walk, or cycling (World Health Organisation, 2010). Vigorous intensity PA (VPA) requires a large amount of effort and causes rapid breathing and substantial increase in heart rate, for example running or fast cycling (World Health Organisation, 2010). In addition to the 60 minutes MVPA, it is recommended that vigorous intensity weight-bearing activities that strengthen muscle and bone be integrated into children's PA sessions at least 3 days a week. It is also recommended that all children and young people should minimise the amount of time spent being sedentary (Chief Medical Officers, 2011; World Health Organisation, 2010).

Meeting the PA guidelines outlined above is important for lowering mortality risk and those who participate in more VPA may experience lower risks (Kikuchi et al., 2017). MVPA is consistently associated with fitness in children and young people, and should be the primary target of public health recommendations but, breaking up long period of ST should also be strongly considered (Júdice et al., 2017). Substituting ST with MVPA is associated with positive effects on children's body composition (Sardinha, Marques, Minderico, & Ekelund, 2017). Substituting ST with VPA is associated with favourable cardio respiratory fitness (Santos, Marques, Minderico, Ekelund, & Sardinha, 2017) and waist circumference for children and young people (Moore, Beets, et al., 2017). More MVPA is beneficial for children and young peoples' metabolic health and weight status, whereas lower ST is beneficial for metabolic health alone (Kuzik et al., 2017). Moreover, higher MVPA levels in children and adolescents are associated with reduced cardiometabolic risk, regardless of the amount of ST (Ekelund et al., 2012). Efforts aimed at replacing ST with active

behaviours, particularly those of at least moderate intensity, appear to be an effective strategy to reduce cardiometabolic risk in children and young people (Hansen et al., 2018).

Inactive adolescents are more at risk of being overweight or obese and have a greater chance of developing diabetes (World Health Organisation, 2014). Physical inactivity is a major risk factor for not only physical health but social and mental health also (Aryu, Clark, Hunter, & James, 2013; World Health Organisation, 2010). Physically inactive children have a greater risk of low self-esteem, depression, lower scores on health-related quality of life and emotional and behavioural disorders, and these children are more likely to engage in negative behaviours such as smoking, drug use and having higher alcohol consumption compared to their physically active counterparts (Korhonen, Kujala, Rose, & Kaprio, 2009; Rankin et al., 2016).

2.2. Health Risks of Sedentary Time

Childhood overweight and obesity measurements are commonly used indicators of health status, and in the England over a third of children are overweight and 20% are classified as obese (Public Health England, 2017). A review on PA and obesity in children and young people found that across time, active behaviours have become less frequent and replaced by more sedentary activities such as, TV viewing, gaming and phone usage (Hills, Andersen, & Byrne, 2011). This has contributed towards reductions in children and young peoples' energy expenditure (Hills et al., 2011). Researchers have found that common sedentary activities, such as TV viewing, are strongly correlated to increased risk of obesity in childhood and adolescence (Biddle, Pearson, Ross, & Braithwaite, 2010; Pardee, Norman, Lustig, Preud'homme, &

Schwimmer, 2007). Additionally, findings show that in obese children, time spent watching TV is associated with both hypertension and the severity of obesity (Pardee et al., 2007).

Prolonged periods of ST lead to the greatest health risks among young people (Owen, Healy, Matthews, & Dunstan, 2010). Moreover, researchers suggest that decreasing any type of SB is associated with lower health risk in children and young people (5-17 years old) (Tremblay et al., 2011). Notably, the findings show that more than 2 hours daily TV viewing is associated with unfavourable body composition, decreased fitness, lowered scores for self-esteem and pro-social behaviour and decreased academic achievement (Tremblay et al., 2011). Similarly, evidence shows that screen time is deleteriously associated with numerous health indicators in children and young people including; adiposity, aerobic fitness, quality of life, self-esteem, pro-social behaviour, academic achievement, depression and anxiety (Saunders & Vallance, 2017). Negative associations have also been identified between screen time and physical activity/fitness, screen time and psychological well-being, and screen time and social support. (Costigan, Barnett, Plotnikoff, & Lubans, 2013).

There is strong and consistent evidence for the positive association between screen-based SB and weight status (Costigan et al., 2013; Saunders & Vallance, 2017). However, reducing ST can lead to reductions in Body Mass Index (BMI) (Mitchell & Byun, 2013). Furthermore, it has been found that overweight or obese children and young people tend to become overweight or obese adults, thus an increasing number of children may face chronic disease in later life (Biddle et al., 2010). The evidence to date suggests a need reduce ST, with a focus on screen-based behaviours, in order to

minimise the negative health consequences for children and young people (Saunders & Vallance, 2017).

2.3. Measurement of PA

PA can be measured using a range of methods including self-report questionnaires, heart rate monitors, direct observations, pedometers, and accelerometers (Dishman, Washburn, & Schoeller, 2001). Although, PA is a multi-dimensional construct and thus, no one measure is able to assess all facets of PA (Dollman et al., 2009; Sylvia, Bernstein, Hubbard, Keating, & Anderson, 2014). Each method stated above has been used with children and young people to measure their PA behaviours, with varying levels of accuracy (Dishman et al., 2001). Researchers must consider multiple aspects before selecting an appropriate method of measurement including; population (age); sample size; respondent burden; method/delivery mode; assessment time frame; physical activity information required (data output); data management; measurement error; cost (instrument and administration) and other limitations (Dollman et al., 2009; Sylvia et al., 2014).

Self-report questionnaires are the most common method of PA assessment and rely on participants' recall ability (Castillo-Retamal & Hinckson, 2011). Self-report questionnaires are cheap to administer and relatively easy to use with children and young people (Besson, Brage, Jakes, Ekelund, & Wareham, 2009; Corder et al., 2009). Self-report questionnaires are significantly more reliable when used to assess group level PA compared to individual level (Corder et al., 2009; Shephard, 2003). In addition, when questionnaires are structured chronologically and with discrete

periods, such as the Youth Activity Profile (YAP) (Saint-Maurice & Welk, 2014) reliability is improved (van der Ploeg et al., 2010).

The YAP (Saint-Maurice & Welk, 2014) measures before, during and after school PA and SB habits. The YAP (Saint-Maurice & Welk, 2014) has been validated and calibrated against an objective method to provide reliable estimates for youth MVPA levels and ST at the group level (Saint-Maurice & Welk, 2015). However, there are several disadvantages to use of self-report questionnaires. The questionnaires are based on participants' recall, which can be problematic when working with children and young people (Corder et al., 2009; Trost, 2001), and are less robust in measuring or assessing energy expenditure (Shephard, 2003) and can be influenced by external factors (i.e., social desirability, complexity of the questionnaire, age, and seasonal variation) (Braun, Jackson, & Wiley, 2001; Corder et al., 2009; Vanhees et al., 2005).

Recently, accelerometers have increased in usage mainly due to significant technological and data processing developments, and improved accuracy of devices (Sylvia et al., 2014; Troiano, McClain, Brychta, & Chen, 2014). Accelerometers provide a direct assessment of PA frequency, intensity and duration, unlike self-report PA measures (Dollman et al., 2009), and reduce bias (Reilly et al., 2008). Accelerometers provide the ability to capture large amounts of data, are relatively easy to administer, and can measure a range of intensities (Rachele, McPhail, Washington, & Cuddihy, 2012; Westerterp, 2009). They provide accurate estimates of both static and dynamic behaviours, have large memory capacities, are not reliant upon accurate recall and are not influenced by social desirability (Rachele et al., 2012; Rowlands, 2007; Sylvia et al., 2014; Trost, 2001).

The sampling capabilities of accelerometers allow researchers to investigate different periods of the day or week (Fairclough, Hilland, Stratton, & Ridgers, 2012; Fairclough, McGrane, et al., 2016a; Taylor et al., 2017). This is beneficial for school-based research investigating differences in discrete periods and segments of the school day including; break time, physical education (PE) lessons, and normal lesson time (Taylor et al., 2017). However, accelerometers have several limitations. They are expensive; require technical expertise, specialised hardware, software, and individual programming (Dollman et al., 2009; Trost, 2001; Van Hees et al., 2013). Accelerometers also lack a standard protocol for managing or reducing data, do not provide any contextual information and are not waterproof (Dollman et al., 2009; Hardy et al., 2013).

Nevertheless, accelerometers are the most widely used objective estimate of youth PA (Cain, Sallis, Conway, Van Dyck, & Calhoun, 2013). Accelerometer devices can be worn in numerous locations on the body (e.g. wrist, hip, thigh) with similar accuracy for capturing free living PA (Chen, Janz, Zhu, & Brychta, 2012; Cleland et al., 2013). More recently, there has been shift to the use of wrist worn devices, rather than hip-worn, which has been found to reduce missing data and improve wear time compliance with children and young people (Fairclough, Noonan, et al., 2016; Scott et al., 2017). Increased wear time reduces selection bias due to the exclusion of participants with insufficient data and helps improve the accuracy of the objective PA estimates (Toftager et al., 2013; Tudor-Locke et al., 2015). Accelerometers quantify acceleration in real time and detect movement in up to three orthogonal planes (anteroposterior, mediolateral, and vertical) (Chen & Bassett, 2005; Rachele et al., 2012). Data outputs from accelerometers, such as counts or raw acceleration

signals provide an explicit representation of acceleration due to bodily motion over short time periods (<1 second to 1 minute) determined by the device settings (Freedson, Pober, & Janz, 2005; Troiano et al., 2014).

Raw data usage allows for greater transparency and comparability between studies compared to the proprietary counts-based approach. More recently, studies have used raw accelerations instead of counts (Fairclough, McGrane, et al., 2016a; Noonan, Boddy, Kim, Knowles, & Fairclough, 2017; Taylor et al., 2018; Taylor et al., 2017). Most commonly used accelerometers (i.e. ActiGraph GT3X+ and GT9X models and GENEActiv devices) are capable of capturing and storing these raw, unfiltered acceleration signals (Noonan et al., 2017). This is a relatively novel approach to handling PA data and is a constantly developing field (Hildebrand, Hansen, van Hees, & Ekelund, 2017; Rowlands et al., 2017). Compared to the count based approach, raw data analysis provides researchers greater control over their post-data procedures (i.e. data handling and analysis) and arguably leads to a more accurate representation of PA behaviours.

2.4. Methodological Approach

Previous research investigating PA behaviours has largely focused on quantitative assessments of PA as detailed above. However, quantitative research tends to focus on analysis (i.e. taking part and examining components of a construct), whereas qualitative research seeks to understand the meaning of an experience to the participants in a specific setting (Creswell & Clark, 2017; Thomas, Silverman, & Nelson, 2015). Quantitative methodologies generally look to analyse figures of measurements of PA, which lack contextual information and meaning behind PA behaviours.

Sometimes the nature of the research problem dictates the research methodology selected (Tariq & Woodman, 2013), for example, a meta-analysis of previous research would only require a quantitative approach as it looks to analyse a specific area of construct of interest. When quantitative and qualitative research methodologies are used in isolation with school based PA research, they often do not provide a complete picture of the area of interest.

A mixed-methodological research approach, combining quantitative and qualitative methodologies allows for both the objective measurement PA in the school setting and personal accounts from children regarding the meaning behind their PA behaviours (Jago et al., 2012; Taylor et al., 2018; Thomas et al., 2015). This mixed-methodological approach allows for a more comprehensive analysis and the ability to answer a broader range of research questions (Tariq & Woodman, 2013). The strengths of one method can be used to overcome the weaknesses of another method (Creswell & Clark, 2017), for example, PA diaries can be combined with accelerometer results to provide a measurement of PA and location and type of PA. Similarly, the results from the different methods applied may validate each other each and provide stronger evidence for a conclusion. Importantly, a mixed-methodological approach can add insights and understanding that may be otherwise missed with a singular research approach (Tariq & Woodman, 2013).

2.5. Prevalence of PA and ST in Adolescents

Previous research has illustrated that PA levels decrease during the transition from childhood to adolescence, with girls showing significant declines in participation (Dumith, Gigante, Domingues, & Kohl III, 2011). Findings suggest that globally, 80% of

13–15-year-olds do not engage in 60 minutes of MVPA per day, with girls being less active than boys (Hallal et al., 2012). Objectively measured accelerometry data from multiple continents suggests that among 5-17 year olds, only 9% of boys and 1.9% of girls achieved the recommended 60 minutes of MVPA (Cooper et al., 2015). Boys were more active than girls and, both boys' and girls' activity levels declined through adolescence. A review of 26 longitudinal studies concluded that there is a 7% decrease in total PA per year during adolescence (Dumith, Gigante, Domingues, & Kohl III, 2011). The decline of VPA for youth appears to be greater than for MPA, with girls' age related decline for VPA greater compared to boys' (-11% versus -3%) (Corder, Sharp, et al., 2016)

In 2016, 22% of English children and young people (aged 5-15 years) met the recommended 60 minutes of MVPA guidelines (Public Health England, 2017). However, only 16% and 9% of girls aged 11-12 and 13-15 respectively met to the guidelines (Public Health England, 2017). Thus, adolescent girls have been highlighted as a group at risk to declining PA levels. Recent evidence suggests that PA beings to decline from the age of 7, for both boys and girls (Farooq et al., 2017). Regardless of the exact start of decline, girls' PA levels decline at a steeper and faster rate to boys once they enter secondary school (Public Health England, 2017). There is a need for novel approaches to reduce this decline and the related health concerns.

The decline of PA during adolescence is a consistent finding in the literature (Dumith, Gigante, Domingues, & Kohl III, 2011). More recently, there has been an increase in children and young people's attraction to sedentary pursuits. Researchers have found that PA and ST patterns are established in childhood and these patterns carry through

to adolescence (Telama, 2009), and track strongly into adulthood (Biddle et al., 2010; Telama et al., 2014). In England, 9% of children and young people (2-15 years old) were sedentary, whether for TV viewing or other sedentary time (excluding time at school), for six hours or more per day on weekdays, and 19% on weekend days (Public Health England, 2016). Time spent being sedentary, both during the week and at weekends, increased with age for both boys and girls. Adolescent girls had the greatest increases in ST, 7% of girls (8-10 years old) were sedentary for 6 hours or more on weekdays and 19% on weekends (Public Health England, 2016). Whereas, 23% of girls (13-15 years old) were sedentary for 6 hours or more on weekdays and 36% on weekends (Public Health England, 2016).

2.6. Correlates of PA

PA is a complex and multi-dimensional behaviour determined by numerous biological, psychological, socio-cultural and environmental factors (Bauman et al., 2012; Sterdt, Liersch, & Walter, 2014). Understanding why people are physically active or inactive is important to inform public health policies and interventions to target identified factors (Bauman et al., 2012). Age, sex, health status, self-efficacy, and motivation are common correlates of PA across the lifespan (Bauman et al., 2012).

Children's and adolescents' PA levels are correlated with a range of demographic/biological (age and gender), psychological (positive motivation, positive body image, the existence of barriers), behavioural (previous PA, sport participation, smoking, ST) and socio-cultural factors (parental influence, social support) (Biddle, Atkin, Cavill, & Foster, 2011; Sallis, Prochaska, & Taylor, 2000; Sterdt et al., 2014). Although, age and gender were consistently identified as the strongest correlates of

PA for children and adolescents (Biddle et al., 2011). Enjoyment of PA, self-efficacy related to barriers to PA, perceived social support for PA, perceived social inclusion, perceived environmental opportunities for PA and the behaviour itself have been found to be moderately stable correlates of PA in the transition between childhood and adolescence (Gebremariam et al., 2012).

Adolescents have self-reported their PA behaviours to occur in three specific contexts: (1) school commuting, (2) informal games play at school and (3) organized sport, structured exercise and games play in leisure time (Ommundsen et al., 2006). The impact of peer support, enjoyment and perceived competence in physical activity is associated with PA across the three locations, highlighting their importance to adolescent PA behaviours (Laird, Fawcner, Kelly, McNamee, & Niven, 2016; Ommundsen et al., 2006).

Moreover, adolescent girls are an at risk population for inactivity (Dumith, Gigante, Domingues, & Kohl III, 2011; Hallal et al., 2012), thus their correlates require greater attention for researchers and policy makers. For adolescent girls, PA is positively associated with a range of factors including enjoyment, perceived PA competence, PA self-efficacy, physical self-perceptions and parental PA support (Biddle, Whitehead, O'Donovan, & Nevill, 2005; Budd et al., 2018; Laird et al., 2016). Behavioural correlates showed that organised sport involvement was associated with greater activity and smoking was associated with lower PA levels (Biddle et al., 2005). Furthermore, MVPA is well established as the most beneficial form of PA for good health. Parental and peer social support exert a strong influence on adolescent MVPA (Beets et al., 2010; Silva et al., 2014). For 11-14 year old girls, higher MVPA is positively associated with

lower percent body fat, higher social support from friends, and lower school math scores (Young, Saksvig, Wu, Zook, Li, et al., 2014).

2.7. School-based PA Interventions

School-based interventions have been reported to be effective for increasing youth PA (Kriemler et al., 2011; Pearson et al., 2015; Van Sluijs, McMinn, & Griffin, 2007). The school-based application of multicomponent intervention strategies with underpinning theory is viewed as the most consistent and promising strategy (Camacho-Minano et al., 2011; Kriemler et al., 2011; Owen et al., 2017; Pearson et al., 2015; Van Sluijs et al., 2007). Children have been found to be most active during the school day compared to weekends and evenings (Fairclough et al., 2012), which may be related to the structured nature of school and numerous opportunities for PA (e.g., PE lessons, break times, lunch times).

With low levels of PA in adolescent girls (Cooper et al., 2015; Hallal et al., 2012) mandatory timetabled PE lessons are generally seen as a good foundation where PA can be promoted within schools (Stratton, Fairclough, & Ridgers, 2008). Due to PE being mandatory for students for all or part of secondary education it has the potential to reach the majority of the adolescent population (Trudeau & Shephard, 2005). In addition, the school environment provides an infrastructure of staff and facilities that can be utilised as part of PA interventions. Although PE lessons are an obvious setting for PA interventions, their impact is limited as children and young people may only have one or two PE lessons per week. Morning and lunch breaks along with before and after school clubs are useful points to intervene, providing opportunities

throughout the school day and across the school week to promote PA (Ridgers, Knowles, & Sayers, 2012).

Comprehensive School Physical Activity Programming (CSPAP) is one approach suggested by policy makers in the United States to target PA behaviours in the school setting (Centers for Disease Control and Prevention, 2013). CSPAPs are multi-component in nature and were designed to provide youth and school staff with multiple opportunities in school to be physically active, meet the globally recommended 60 minutes of PA each day, and develop the knowledge, skills, and confidence to be physically active for a lifetime (Centers for Disease Control and Prevention, 2013). CSPAPs have five main components; quality PE, PA before, and after school, staff involvement, and family and community engagement. PE as a taught academic subject serves as the foundation of the CSPAPs. It is hypothesised that youth can accumulate the recommended amount of PA through the provision of the multi-component CSPAP (Centers for Disease Control and Prevention, 2013). Although, it is unclear how best to implement these approaches (Moore, Carson, et al., 2017)

Researchers have recommended the development of these CSPAP (Hills, Dengel, & Lubans, 2015; Lee, Burgeson, Fulton, & Spain, 2007), and findings support the effectiveness of these CSPAP approaches to increase PA and improve health outcomes. A 36-week CSPAP with 11 year old children found Improvements in specific cardiometabolic health markers (i.e., High-density lipoprotein cholesterol, triglycerides, and mean arterial pressure) from pre to post intervention (Burns, Brusseau, & Hannon, 2017). Similarly, a review of CSPAP's found a plethora of evidence to support the positive PA outcomes through each CSPAP component, but

physical education, and PA before and after school were particularly effective (Erwin, Beighle, Carson, & Castelli, 2013). This had led to researchers calling on public health providers to adopt a wide scale implementation of CSPAP's with high quality PE as the central component (Hills et al., 2015).

Camacho-Minano et al. (2011), systematically reviewed interventions to promote PA among young and adolescent girls. They found that the most effective, and methodologically stringent interventions, were multicomponent school-based interventions that also offer PE that addresses the unique needs of girls. The review promoted the use of peer strategies, which had shown promising evidence to be effective within this population. PE was a common component of the majority of the successful interventions. Making PE more enjoyable for girls and increasing the amount of activity choice and non-competitive opportunities were central to these successful interventions (Jamner, Spruijt-Metz, Bassin, & Cooper, 2004; Rosenkranz, Behrens, & Dzewaltowski, 2010; Schneider et al., 2007; Story, Sherwood, Himes, Davis, Jacobs, Cartwright, Smyth, et al., 2003; Young, Phillips, Yu, & Haythornthwaite, 2006).

The multicomponent PA for everyone (PA4E) intervention, including 'active PE lessons' improved whole day minutes of VPA, school day MVPA, PE lesson quality, and school physical activity practices. (Sutherland et al., 2017). The ability of the interventions to facilitate adequate MVPA during PE lessons was also important for successful studies identified in the systematic review (Camacho-Minano et al., 2011; Fairclough & Stratton, 2005b; Young et al., 2006). It is recommended in the United States (Centers for Disease Control and Prevention, 2010) and the United Kingdom (Association for Physical Education, 2015) that 50% of PE lesson time should be spent

in MVPA. However, two recent reviews highlighted that in primary schools (elementary) 44.8% of PE lesson time is spent in MVPA (Hollis, Williams, et al., 2016), and in middle and high schools only 40.5% (Hollis et al., 2017). Moreover, some school-based PA interventions incorporating PE have had to battle a reduction in curriculum time and the low perception of importance PE has within schools, which limits the influence of PE on youth PA and especially girls' PA (Camacho-Minano et al., 2011; Dudley, Okely, Pearson, & Peat, 2010).

Furthermore, enjoyment has found to be important to increase PA in PE. The LEAP intervention study (Pate et al., 2005) aimed to promote enjoyable and successful PE experiences among adolescent girls through modifications to the PE environment. Researchers increased choice of activities, girl only classes, inclusion and small group interaction (Dishman et al., 2005). The researchers determined that this approach increased girls' enjoyment of PE, which resulted in higher levels of daily PA. There is, however, potential that adolescent girls' PE enjoyment may be influenced more by the opportunities for social interaction with friends than enjoyment of PA in general (Grieser et al., 2008). Adolescent girls face numerous perceived barriers with increasing age (Sherar et al., 2009), thus it is important that interventions target early adolescents to highlight the value and relevance of PE and PA programmes (Camacho-Minano et al., 2011).

Additionally, a school-based PA intervention designed to encourage adolescent girls to be more physically active found that baseline enjoyment moderated the effect of the intervention on VPA (Schneider & Cooper, 2011). Girls with low enjoyment of PA at baseline increased VPA from pre to post intervention however, girls with high

enjoyment of PA at baseline showed no pre to post change for VPA. This suggests that school-based PA interventions that target identified barriers to PA among inactive to low active adolescent girls may be more beneficial for adolescent girls with low enjoyment of PA.

During the school years, a combination of biological and psychosocial factors dictate that adolescent girls in particular are at greatest risk of inactivity and uptake of sedentary lifestyles (Young, Saksvig, Wu, Zook, Xia, et al., 2014). Thus, without intervention the decline in activity levels will continue and in turn, the uptake of more SB and a lack of PA could have negative health consequences for children and young people as they move through adolescence (Janssen & Leblanc, 2010). Moreover, interventions that attempt to maintain PA levels or attenuate the PA decline, even without an increase in PA levels, could be considered as effective (Dumith, Gigante, Domingues, & Kohl, 2011).

2.8. Peer-led Approach

One strategy that is relatively underused and consequently understudied in school PA interventions is the use of peer-led approaches (Jenkinson et al., 2012). *Peer leadership, peer-led, and peer-assisted learning* are frequently used interchangeably. The commonality is that each strategy is underpinned by a learning process whereby students learn from and with others (Jenkinson et al., 2012). Peer-led involves similar aged peers (Jenkinson et al., 2012), interacting with and motivating their friends to initiate, continue and sustain positive behaviour (Barr-Anderson et al., 2012; Campbell et al., 2008). The combination of school-based PA interventions and peer-led schemes could serve as a model to engage youth in PA within school in addition to promoting

PA outside of school through the peer influence (Corder, Schiff, Kesten, & van Sluijs, 2015).

It has been established that peers play a central role in influencing adolescents' PA through providing peer support, co-participation in PA, peer norms, friendship quality, peer affiliation and peer victimisation (Fitzgerald, Fitzgerald, & Aherne, 2012; Silva et al., 2014). Moreover, girls who frequently take part in PA with their best friend, obtain higher levels of PA (Jago et al., 2011). Combined with the youth population having a tendency to be susceptible to persuasion and social pressures, researchers have suggested that friends and friendship groups may influence the initiation and maintenance of youth PA (Jago et al., 2009). This is supported by a recent review which found that social influences are important factors for ensuring participation, maximizing the quality of the experience, and capitalising on the benefits of youth PA (sport) (Howie, Daniels, & Guagliano, 2018).

Furthermore, adolescents girls have reported enjoyment of PA as the main reason for engaging in MVPA with friends and girls with active friends were more likely to be physically active and spend less time engaging in screen-based behaviours (Garcia, Sirard, Deutsch, & Weltman, 2016). It has been suggested that interventions aiming to increase MVPA in children and young people should be designed to include the recruitment of friends to increase enjoyment of MVPA (Garcia et al., 2016). Building upon existing peer processes and structures in schools may be particularly useful with adolescent girls to promote peer support, peer assisted learning and peer communication (Fitzgerald et al., 2012). Future interventions should utilise friendship

groups as an effective way to promote increased PA in young people (Jago et al., 2009).

Previously, peer-led interventions have targeted a range of health behaviours amongst young people, including smoking (Campbell et al., 2008), eating disorders (Ciao, Latner, Brown, Ebner, & Becker, 2015), alcohol consumption (Thomas & Ward, 2006), and PA and sedentary behaviour (Barr-Anderson et al., 2012; Corder, Brown, et al., 2016; Harrington et al., 2018; Jenkinson et al., 2012). A review of peer-led PA interventions, identified only ten for review, found only two targeted youth (Lieberman, Dunn, Van der Mars, & McCubbin, 2000; Thomas & Ward, 2006) and neither was conducted in the UK (Ginis et al., 2013). The review suggested that peer-led interventions have potential but with youth populations, there is a lack of high quality controlled trials, which are underpinned by appropriate theory (Ginis et al., 2013).

Peer-led PA interventions have shown the ability to increase MVPA levels (Barr-Anderson et al., 2012; Corder, Brown, et al., 2016). The Go Active (Get Others Active) intervention incorporated a tiered peer-led approach for both boys and girls (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Corder et al., 2015). The intervention aimed to increase PA through increased peer support, self-efficacy, self-esteem and friendship quality. The intervention was implemented using a tiered-leadership system where mentors (older adolescents within the school) and peer-leaders (within each class) encourage students to try a series of new activities each week provided by the research team. For example, Ultimate Frisbee, Zumba and Hula Hoop. The main intervention components were delivery during registration group sessions at the

beginning of the day with support from the class teacher. The mentors remain paired with each class for the duration of the intervention whereas the peer-leaders (two per class each week, one male and one female) changed every week. The intervention was based on six key constructs providing students with choice, novelty, mentorship, competition, rewards, and flexibility (Corder, Brown, et al., 2016; Corder et al., 2015). The Go Active intervention used a combination of SCT, SDT and Theory of Planned Behaviour (TPB) to underpin their peer-led approach for adolescents although, little is reported on the direct links from theory to intervention components (Corder, Brown, et al., 2016; Corder et al., 2015). The intervention has been tested in four pilot schools, and has shown to be effective in increasing daily MVPA levels by 5.1 minutes (Corder, Brown, et al., 2016).

Similarly, other behaviour change theories have been incorporated into recently developed peer-led approaches with adolescents. The 'Girls Active' programme was guided by SCT (Edwardson et al., 2015; Harrington et al., 2018). The SCT incorporated a structure to target multiple levels of influence on behaviour (i.e. personal, social and environmental) (Edwardson et al., 2015). The researchers embedded the SCT throughout the Girls Active intervention including; creating choice, increasing access and availability and physical opportunities to be active and fostering social support through positive peer relationships or friends. As part of a multicomponent approach, also incorporated into the intervention activities were core SCT constructs: observational learning, self-regulation and self-monitoring (Edwardson et al., 2015). After finding short-term positive impacts of the intervention on girls' MVPA levels the intervention showed no change in MVPA levels at 14-month follow up. However, this

was a flexible approach utilised, meaning the schools had greater control over implementation and in larger school the results were more promising in relation to MVPA.

Interventions promoting PA in the school environment delivered by older mentors or role models, such as the Go Active intervention, have been suggested as more appealing to adolescents than interventions delivered by teachers or researchers (Corder, Brown, et al., 2016). Adolescent health behaviours such as nutrition (Black et al., 2010), smoking cessation (Campbell et al., 2008), and sexual health (Davey-Rothwell et al., 2011) have been improved using cross-age mentorship interventions previously. However, cross-age mentorship has been understudied in PA research with young people (Ginis et al., 2013; Smith, 2011).

The GLAMA (Girls! Lead! Achieve! Mentor! Activate!) intervention incorporated a cross age component to develop and foster leadership skills in Year 10 girls (15-16 years old) so they were capable of leading a group of Year 7 girls (12-13 years old) in a range of physical, cognitive and team focused activities (Jenkinson et al., 2012). The GLAMA intervention was underpinned by the SCT and incorporated competitive elements to encourage greater engagement in PA. However, the GLAMA process evaluation identified several school level barriers which impeding the planned delivery of the intervention. These included the structure of the curriculum, timetabling, pressure to meet curriculum and assessment content, lack of support for new initiatives, multiple programmes already running within the school, time allowances for teachers, and appropriate training for teachers (Jenkinson et al., 2012). That said, the intervention was well received by peer leaders, peers and teachers,

leading researchers to recommend the cross age intervention to be implemented over a longer duration (Jenkinson et al., 2012).

Similarly, cross-age mentoring approaches have been adopted to encourage walking groups in school (Carlin, Murphy, & Gallagher, 2016; Carlin, Murphy, Nevill, & Gallagher, 2018). A school walking intervention for adolescent girls, underpinned by SCT, utilised a number of strategies (i.e. observational learning and vicarious experiences) to develop girls' PA self-efficacy (Carlin et al., 2018). The intervention increased daily light PA (LPA) levels but did not change MVPA levels. Self-selected walking speeds were identified as a contributing factor towards no observed change in MVPA levels. However, the leadership approach with adolescent girls was feasible and can change PA behaviour in the short term (Carlin et al., 2018).

Moreover, if peer assisted learning is conducted within a same age or cross age context then leadership opportunities are also provided for students (Jenkinson et al., 2012). Whilst undertaking the role of 'peer leader' or 'peer tutor', the benefits reported have included; increased self-determination, enhanced understanding of concepts, improved reorganisation, clarification, and knowledge building skills (Jenkinson et al., 2012). Barr-Anderson et al. (2012) found that utilising peer leadership with PA promotion DVDs and teacher's guidance was an effective way to promote PA among 11-12 year olds. This programme was based around the SCT incorporating personal factors (self-efficacy, skills building), social factors (peer influence, norms, social support), and environmental factors (incentives, role models, and access to PA support). This approach used peers alongside teachers to co-deliver the intervention material. Although this was a pilot study using a small sample,

intervention students did report an increase in MPA and specifically girls who received the intervention reported increases in MVPA (Barr-Anderson et al. 2012). Student peer leaders were able to facilitate and deliver the activities and with an intervention effect found, this method warrants further consideration and investigation in future PA interventions.

A peer-led approach targeting healthy eating illustrated that peer leaders enjoy their role, help facilitate the programme and significantly enhance the success of the programme (Story et al. 2002). Peer-led learning in relation to PA may overcome some aspects that impede student learning, such as enjoyment and participation by providing opportunities for increased levels of feedback, social learning and less direct instruction from the teacher (Meztler, 2005). The Go Active intervention utilised teachers to support the intervention, but mentors and leaders delivered the main intervention components (Corder, Brown, et al., 2016; Corder et al., 2015). Moreover, teachers generally provide students with factual information, peers can be seen as credible sources of social information and role models for positive behaviour.

However, previous peer-led approaches have centered on formal methods of peer to peer delivery (e.g. leading educational classes, organised co-participation and formal advice giving) which are both time limited and intensive (Ginis et al., 2013). An alternative peer-led approach is to train peer supporters to informally diffuse health promotion messages to their peers (Bell, Audrey, Cooper, Noble, & Campbell, 2017; Campbell et al., 2008; Sebire, Edwards, Campbell, et al., 2016). The ASSIST (A Stop Smoking in Schools Trial) intervention adopted the Diffusion of Innovations Theory (Rogers, 2010) and applied its concepts to informally diffuse stop smoking messages

through social groups (Campbell et al., 2008). The ASSIST intervention was a cluster randomised control trial (cRCT) comprising of 10,730 school children aged 12–13 years from England and Wales (Campbell et al., 2008). Those who received the ASSIST intervention had lower odds of being a smoker compared to pupils in the control condition immediately after the intervention and at 1 and 2 year follow up (Campbell et al., 2008). This illustrates the potential of the peer-led approach to improve health related behaviours.

This peer-led approach, utilising the Diffusion of Innovations Theory (Rogers, 2010), has been found to be feasible and acceptable with young adolescents as part of an obesity prevention intervention (Bell et al., 2017). However, this intervention targeted two health behaviours (i.e. PA and diet), and was not effective increasing healthy eating behaviours or PA levels. Targeting two health behaviours was deemed too complex for the peer-led approach (Bell et al., 2017). Informal school-based peer-led interventions can be effective in changing young peoples' health behaviours, but messages need to be simple and clear (Sebire, Edwards, Campbell, et al., 2016).

In a recent protocol paper Sebire, Edwards, Campbell, et al. (2016) outlined the first use of the Diffusion of Innovations (Rogers, 2010) approach to specifically increase PA levels of adolescent girls. The intervention will be underpinned by the SDT to guide the intervention content and relevant behaviour change techniques (Michie et al., 2013). Peers will receive training in order to stimulate the development of autonomous motivation. Autonomous motivation is supported by the degree individuals perceive the satisfaction of three psychological needs: autonomy, competence and relatedness (social belonging) (Deci & Ryan, 2002). Through a peer-

led approach Sebire, Edwards, Campbell, et al. (2016) hope to foster a social environment for adolescent girls which supports health motives, perceptions of competence, connectedness, social support and options of how to be physically active (Slater & Tiggemann, 2010).

Interventions which target theoretical mechanisms of behaviour change are likely to be more effective than those that do not (Michie et al., 2013). Although, few peer-led PA interventions incorporate theoretical principles (Ginis et al., 2013). SDT is well suited to a peer-led intervention model because it allows for the development of a social climate to facilitate friends' interest in PA (Ginis et al., 2013). Peer interaction and influence is heightened during early adolescence and peers are crucial for adolescents to attain the best health behaviours in the transition to adulthood (Viner et al., 2012). Peer leadership has the ability to capitalise on this influential period in a way that has previously not been demonstrated with many school-based PA interventions (Barr-Anderson et al. 2012). Peer-led learning in combination with cross-age mentoring could be of benefit to adolescent girls, providing a novel approach to support their PA behaviours and provide another option to girls who may not be attracted to the sometimes competitive, rigorous, and potentially uncomfortable nature of traditional school-based PA (Jenkinson et al., 2012).

2.9. Summary of Literature

This literature review illustrated the importance of PA to children and young people's health, and established that higher levels of ST is also detrimental to health. Evidence indicates that wrist worn accelerometers are accurate and practical devices to measure children and young people's PA behaviours. PA levels decline through

adolescence, but this decline is greater for girls. Many adolescent girls in England do not engage in the recommended amount of MVPA, which is likely to confer greater health benefits than lower intensity PA. Schools have been shown to be promising settings to intervene with adolescent girls, and interventions that are multicomponent, underpinned by theory, offer choice and increase enjoyment have found to be effective. Current evidence suggests that peer-led approaches present a viable option to promote PA with adolescent girls. Cross-age mentoring in combination with peer-led approaches warrant exploration as little is known about the effectiveness and feasibility of these approaches in schools.

Thesis Study Map

The thesis study map is presented and the beginning and end of each research study chapter to illustrate the objectives and key findings from the four studies presented in this programme of work. The thesis study map introduces the next study and provides a concise summary of the completed study.

Study	Objectives and Key Findings
Study 1 - The Effectiveness of School-Based Physical Activity Interventions for Adolescent Girls: A Systematic Review and Meta-analysis	Objectives <ul style="list-style-type: none"> - Assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. - Systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis.
Study 2 - Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls Peer Activity (G-PACT) Intervention Study	
Study 3 - The Feasibility of a Novel School Peer-led Mentoring Model to Improve the Physical Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project	

Study 4 - The Feasibility
and Acceptability of The
Girls Peer Activity (G-
PACT) Peer-led
Mentoring Intervention

Chapter 3

Study 1: The Effectiveness of School-Based Physical Activity Interventions for Adolescent Girls: A Systematic Review and Meta-analysis

The main outcomes of this review have been published in *Preventive Medicine*:

Owen, M. B., Curry, W. B., Kerner, C., Newson, L., & Fairclough, S. J. (2017). The effectiveness of school-based physical activity interventions for adolescent girls: A systematic review and meta-analysis. *Preventive Medicine*, 105, p.237-249, <https://doi.org/10.1016/j.ypmed.2017.09.018>

The published article can be found in Appendix 9.

3.1. Introduction

Previous systematic reviews (Camacho-Minano et al., 2011; Voskuil, Frambes, & Robbins, 2017) and a meta-analysis (Pearson et al., 2015) have assessed interventions to promote PA in adolescent girls across school and community settings. Voskuil et al. (2017) reported highly variable effect sizes, inferring that PA interventions only had a small effect on objectively measured PA in girls aged 6-18 years (Voskuil et al., 2017). Camacho-Minano et al. (2011) found overall mixed results regarding the effectiveness of PA interventions for adolescent girls but, suggested that multicomponent school-based interventions, which included PE that addressed the unique needs of girls were the most effective. Pearson et al. (2015) reported small but significant effects ($g=0.35$, $p<.001$) for the effectiveness of PA interventions on girls aged 12 to 18 years. Larger effects were found for interventions which were underpinned by theory, school-based, girls only, targeted younger adolescents (ages 12 to 15), multicomponent in design, and that targeted both PA and sedentary behaviour.

Camacho-Minano et al. (2011) and Pearson et al. (2015) suggested that school-based PA interventions are the most promising setting to impact adolescent girls' PA levels.

Thus, this review aims to address this gap in the literature and assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. The inclusion of mixed-sex studies is novel because often reviews (Camacho-Minano et al., 2011; Voskuil et al., 2017) focus only on interventions exclusively designed for girls, when mixed-sex interventions could be equally as effective for girls. The purpose of this study was to systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis.

3.2. Methods

This systematic review was registered with PROSPERO (Registration number: CRD42016037428). This review adhered to the PRISMA reporting guidelines for systematic reviews (Moher, Liberati, Tetzlaff, & Altman, 2009).

3.2.1. Search Procedure

A systematic search was conducted using four electronic databases (PubMed, Web of Science, SPORTDiscus and PsychInfo). Journal articles published in English post 31/12/2004 until the date of the last search (01/12/16) were considered for review. The key words included; physical activity, physical education, sedentary behaviour, sedentary time, walking, sport, fitness, energy expenditure, school, teacher, classroom, gymnasium, sports hall, recess, playtime, break time, playground, before-school and after-school. The search strategies are detailed in the supplementary information (Appendix 1.). Reference lists of retrieved articles were examined for additional articles.

3.2.2. Inclusion and Exclusion Criteria

Studies were eligible if they reported the effects of school-based PA interventions on PA outcomes among adolescent girls (mean age 11-18 years), with the primary outcome being objectively measured or self-reported PA levels. Feasibility and pilot studies were included. Mixed sexed studies were included if girls' data were presented separately to boys' or if girls' data were received upon request. A school-based intervention was defined as one that occurred in the school environment. The extended school day (8am-6pm) was used to operationally define the school day, so as to capture school-based interventions that took place before and after formal hours (e.g., breakfast clubs, boot camps, after-school activities, etc). Studies could be randomised or non-randomised and only published peer-reviewed studies were reviewed. Only journal articles published post 31/12/2004 were considered after preliminary searches ('physical activity' AND 'girls' AND 'intervention') indicated that most interventions had been conducted in the last 10 years with the earliest published in 2004.

All search results were exported into a reference manager (Endnote x7.4, Thomson Reuters) and duplicates were removed. Initially, the first author (MO) screened all titles and abstracts for obvious irrelevance, and a random sample (20%) were also checked by another author (WC). The full-text of eligible studies were then retrieved and reviewed by two authors (MO and WC). Where full texts were not readily available, the lead author was contacted and asked to provide the full text for further assessment on eligibility. If no response was received after a follow-up reminder,

these studies were excluded as they could not be fully assessed for eligibility. Any disagreements were resolved in a meeting involving three authors (MO, WC, and SF).

3.2.3. Data Extraction and Synthesis

Relevant data from the selected studies were extracted by the first author (MO) and checked by the second author (WC) (see Table 3.1.). If studies reported multiple PA outcomes, data for the primary outcome stated in the studies' aims and objectives were used. Any disagreements were resolved through a consensus discussion between MO and WC. A narrative synthesis was completed to provide a summary of school-based PA interventions for adolescent girls (11-18).

Table 3.1. Data Extraction Procedure

Study	(a) Author, year of publication, country
Characteristics	(b) Aims and objectives of study
	(c) Participant characteristics
	(d) Study design
	(e) Intervention content
Theory	(f) Any theory or model that the authors suggest underpins
Underpinning	the intervention, including non-behaviour change
Intervention	theories
PA Measurement	(g) Any measurement tool used to collect PA data, including
Tool	outcome measure of PA
Primary PA Findings	(h) Key findings of each study in relation to PA change due
	to the intervention

3.2.4. Risk of Bias Assessment

Included studies were assessed for risk of bias using a modified tool (Morton, Atkin, Corder, Suhrcke, & van Sluijs, 2016; Pluye, Gagnon, Griffiths, & Johnson-Lafleur, 2009) appropriate for PA reviews which include measures for quantitative experimental and quantitative observational studies. This adapted risk of bias assessment tool (Appendix 2.) used a 1-4 scoring system (i.e., 1= weak, 2= moderate, 3= strong and 4= very strong) at study level as a combined risk of bias score. A higher risk of bias score indicates better methodological quality with a lower risk of bias score indicating poorer methodological quality. Risk of bias was scored on the presence or absence of each criteria respectively (sequence generation and/or randomisation, concealment and/or blinding, complete outcome data and/or low withdrawal/drop-out (<20%), appropriate outcome measure). Studies were scored on what was reported in the current article or if they cited a previously published protocol paper which was examined for further information.

3.2.5. Meta-Analysis

Meta-analytic procedures were conducted in R (<https://cran.r-project.org>) using the metafor package (Viechtbauer, 2010). Studies were included in the meta-analysis if they employed a pre-post control group design. Pre-post intervention PA levels were used as few studies included post-intervention follow up data. The meta-analyses effect size selected was Hedge's *g*, which provides a correction factor for smaller sample sizes ($k < 20$). Meta-analyses were conducted using random effects models to reflect the likelihood of different effect sizes underlying the studies due to the diversity of the included interventions and their implementation (Borenstein, Hedges,

Higgins, & Rothstein, 2010). Heterogeneity was assessed using Cochrane's Q-statistic and I^2 (Higgins, Thompson, Deeks, & Altman, 2003). The Q-statistic and corresponding p value provide a calculation of variance between study effects. A significant Q value indicates systematic differences between the individual studies which might influence the results. I^2 is represented as a percentage with a value of 0% indicating no dispersion and larger values indicating gradual increases in heterogeneity (i.e., 25% = low, 50% = moderate, 75% = high level of heterogeneity (Higgins et al., 2003). Subgroup analyses were performed on possible moderators of the average intervention effect. These were: physical activity measurement method (objective vs. self-report), intervention duration (short vs long), risk of bias (*/** vs. ***/****), intervention design (single component vs. multi-component), presence of underpinning theory (yes vs. no), and the target sex (girls only vs. mixed sex).

Outliers were identified to evaluate the influence of extreme values on the overall treatment effect. Studies with an inflated residual value approximately two standard deviations ($z=\pm 1.98$) above or below the average treatment effect were considered outliers. Publication bias was estimated by examining asymmetry of funnel plots (effect size vs. standard error) where asymmetry is indicative of publication bias (Sterne & Egger, 2001). Following these visual inspections, the trim and fill procedure (Duval & Tweedie, 2000a, 2000b), Orwin's fail safe number (Orwin, 1983) and Egger's regression test (Egger, Smith, Schneider, & Minder, 1997) were used to confirm the presence or absence of publication bias.

3.3. Results

3.3.1. Literature Search

In total, 9,383 records were identified. After screening and eligibility assessments, 20 records met the inclusion criteria for the narrative synthesis (Figure 3.1.).

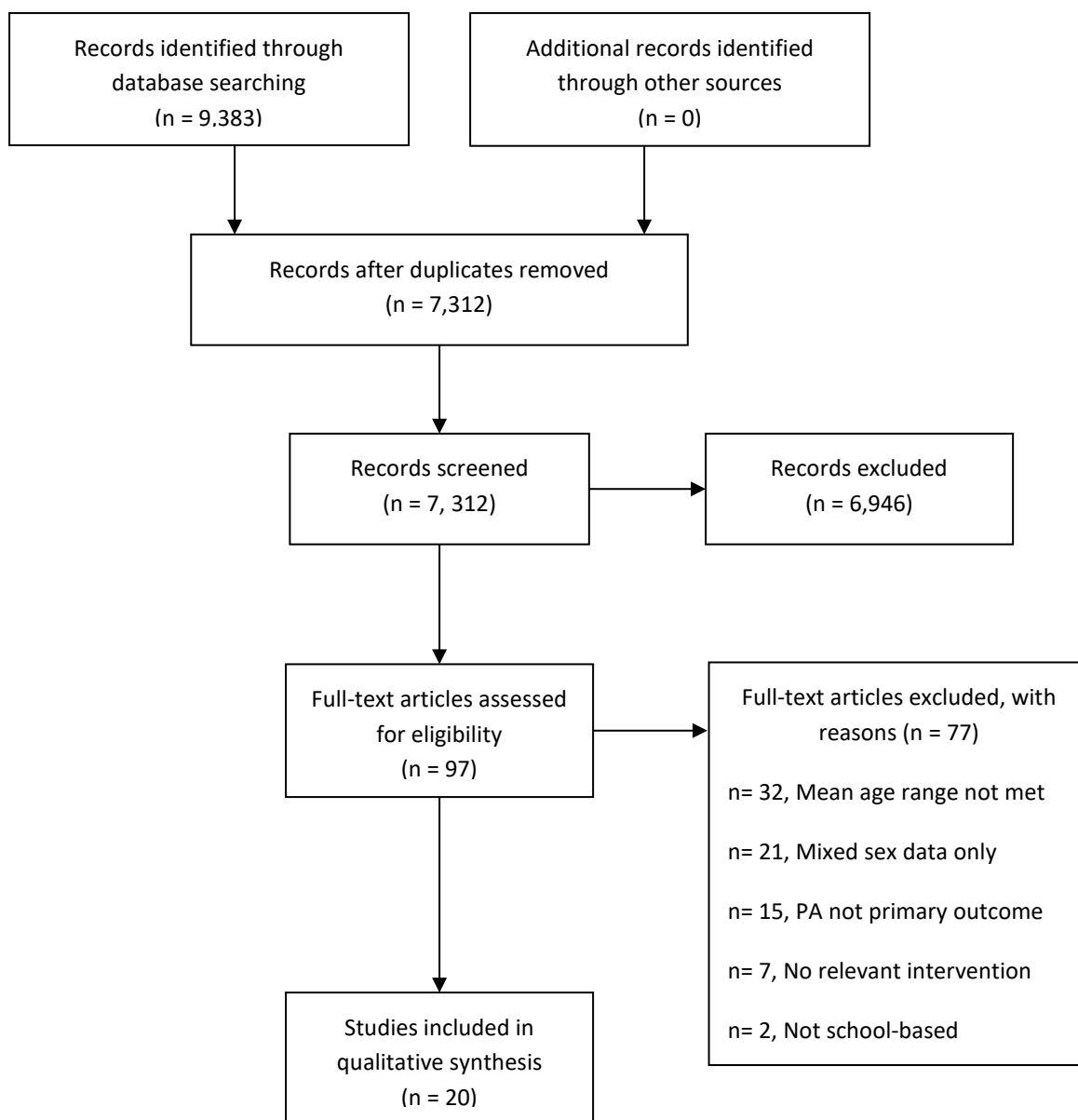


Figure 3.1. PRISMA flow diagram (Moher et al., 2009) to show each stage of the systematic eligibility process.

3.3.2. Participant Characteristics

Table 3.2. provides an overview of participant and study characteristics. In this review, the 20 studies evaluated a total sample of 10,755 girls across the interventions (Mean age = 12.88 years). Four studies reported mixed samples where girls' data were extracted (Bronikowski & Bronikowska, 2011; Haerens et al., 2006; How, Whipp, Dimmock, & Jackson, 2013; Loucaides, Jago, & Charalambous, 2009), with the remaining sixteen studies including girls only samples. The majority of studies were with girls aged 11-14 years, with only three studies (Dudley et al., 2010; Schofield, Mummery, & Schofield, 2005; Taymoori et al., 2008) involving girls aged 15-17 years. Nine studies recruited girls only with no set eligibility criteria stated (Bronikowski & Bronikowska, 2011; Dewar et al., 2014; Fairclough & Stratton, 2005a; Haerens et al., 2006; How et al., 2013; Huberty, Dinkel, & Beets, 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Loucaides et al., 2009; Martin & Fairclough, 2008; Pate et al., 2005). For the remaining eleven studies, four were mixed-sex interventions but reported boys' and girls' PA outcomes separately (Bronikowski & Bronikowska, 2011; Haerens et al., 2006; How et al., 2013; Loucaides et al., 2009). Two studies stated that girls had to be enrolled in two semesters of PE (Jones, Hoelscher, Kelder, Hergenroeder, & Sharma, 2008; Young et al., 2006), two targeted low active girls (Robbins, Gretebeck, Kazanis, & Pender, 2006; Schofield et al., 2005), one targeted girls with low PA enjoyment (Dudley et al., 2010), one targeted girls at the preparation stage of exercise behaviour change, and one targeted girls who did not meet national recommendations for MVPA (Robbins, Pfeiffer, Maier, Lo, & Wesolek, 2012). Seventeen studies contained participant

numbers <1000, with the smallest sample being 15 participants (Martin & Fairclough, 2008). Three studies contained >1000 participants (Haerens et al., 2006; Pate et al., 2005; Webber et al., 2008), with the largest sample being 3502 participants (Webber et al., 2008).

3.3.3. Study Characteristics

Eight studies were conducted in the USA (Huberty et al., 2014; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Robbins et al., 2012; Spruijt-Metz, Nguyen-Michel, Goran, Chou, & Huang, 2008; Webber et al., 2008; Young et al., 2006), with four studies from the UK (Fairclough & Stratton, 2005a; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Martin & Fairclough, 2008), and four from Australia (Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Schofield et al., 2005). There were: fourteen randomised controlled trials (RCTs) (Bronikowski & Bronikowska, 2011; Dudley et al., 2010; Haerens et al., 2006; How et al., 2013; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Webber et al., 2008; Young et al., 2006) including three cluster RCTs (Dewar et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012), and one pilot RCT (Dudley et al., 2010); five quasi-experimental studies (Fairclough & Stratton, 2005a; Loucaides et al., 2009; Martin & Fairclough, 2008; Robbins et al., 2012; Schofield et al., 2005); and one case-crossover study (Huberty et al., 2014). Five studies had PA measurement periods of 12 to 36 months (Bronikowski & Bronikowska, 2011; Dewar et al., 2014; Haerens et al., 2006; Jones et

al., 2008; Webber et al., 2008), including two which utilised a long-term follow-up (i.e., ≥ 12 months) after the cessation of the intervention (Bronikowski & Bronikowska, 2011; Dewar et al., 2014). Eight studies had PA measurement periods of 5 to 12 months (Huberty et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Pate et al., 2005; Robbins et al., 2012; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Young et al., 2006), including four studies that incorporated short-term follow ups (i.e., ≤ 6 months post-end of intervention) (Huberty et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Spruijt-Metz et al., 2008; Taymoori et al., 2008). Seven studies had measurement periods that were less than 4 months and did not include follow-up measurements (Dudley et al., 2010; Fairclough & Stratton, 2005a; How et al., 2013; Loucaides et al., 2009; Martin & Fairclough, 2008; Robbins et al., 2006; Schofield et al., 2005). Eight studies were published since 2010 (Bronikowski & Bronikowska, 2011; Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Huberty et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Robbins et al., 2012).

3.3.4. Intervention Characteristics

Ten studies reported multi-component interventions (Dewar et al., 2014; Haerens et al., 2006; Huberty et al., 2014; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Robbins et al., 2012; Taymoori et al., 2008; Webber et al., 2008; Young et al., 2006). Components included school environment adaptations, modified PE lessons, extra-curricular PA sessions, educational sessions, counselling sessions, and provision of further opportunities to be physically active (e.g., lunch and break time PA clubs). Ten

studies reported single-component interventions. Four of these were modified PE lessons (Bronikowski & Bronikowska, 2011; Dudley et al., 2010; Fairclough & Stratton, 2005a; How et al., 2013; Martin & Fairclough, 2008), three were after-school dance interventions (Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012), two were educational-based interventions (Schofield et al., 2005; Spruijt-Metz et al., 2008) and one was a modified playground intervention (Loucaides et al., 2009). Eighteen of the interventions provided an opportunity for the participants to engage in PA, such as modified active PE lessons, lunchtime PA sessions and after-school PA clubs. Twelve of the interventions incorporated an educational component. Ten interventions lasted for less than 4 months in total duration (Dudley et al., 2010; Fairclough & Stratton, 2005a; How et al., 2013; Huberty et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Loucaides et al., 2009; Martin & Fairclough, 2008; Robbins et al., 2006; Schofield et al., 2005; Spruijt-Metz et al., 2008), with the shortest intervention period being reported as 5-7 days (Spruijt-Metz et al., 2008). Five interventions lasted 6-10 months (Jago et al., 2012; Pate et al., 2005; Robbins et al., 2012; Taymoori et al., 2008; Young et al., 2006), and five lasted for 12-36 months (Bronikowski & Bronikowska, 2011; Dewar et al., 2014; Haerens et al., 2006; Jones et al., 2008; Webber et al., 2008).

3.3.5. Intervention Delivery

Thirteen of the interventions were delivered by school staff including PE teachers (Bronikowski & Bronikowska, 2011; Dewar et al., 2014; Dudley et al., 2010; Fairclough & Stratton, 2005a; Haerens et al., 2006; How et al., 2013; Huberty et al., 2014; Jones

et al., 2008; Martin & Fairclough, 2008; Pate et al., 2005; Spruijt-Metz et al., 2008; Webber et al., 2008; Young et al., 2006). Two were delivered by dance instructors (Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012), who taught dance-specific sessions. Two were delivered by a research team (Schofield et al., 2005; Taymoori et al., 2008), one was delivered by the school nurse and physical activity club instructors (Robbins et al., 2012), and one was delivered through a combination of an online advice programme, a paediatric nurse and a phone-based research assistant (Robbins et al., 2006). One intervention was a playground modification which had no direct deliverer (Loucaides et al., 2009).

Table 3.2. Study characteristics, and key findings from each intervention.

Study	Design & Country	Underpinning Theory	Participants	Intervention Duration & Measurement Period	PA Measurement Method & PA Outcome Measure	Key Findings
1. Bronikowski et al. (2011)	RCT, Poland	Hellison's Model of Teaching Responsibility through PA	n= 170; Mean age= 13.22 (0.3) Mixed sex study	15-month intervention & 30-month study from baseline post-intervention (month 15 to follow-up (month 30).	Self-report & Frequency of weekly leisure-time PA	Significantly increased trends in the frequency of undertaking leisure time PA in INT groups for girls ($p < .01$), differences sustained in the 15-month follow-up after cessation of the intervention.
2. Dewar et al. (2014)	Cluster RCT, Australia	Social Cognitive Theory	n= 357; Mean age= 13.2 (0.5) Girls only study	12-month intervention & 24-month study from baseline to post-intervention (12 months) and follow-up (month 24).	Accelerometry and Self-report & % of MVPA per valid day	No observed improvements for PA levels. Self-report data shows girls in the INT group had a significantly greater reduction in sedentary activities (-56.4 min/day; $p < .05$).
3. Dudley et al. (2010)	Pilot RCT, Australia	Social Cognitive Theory	n= 38; Mean age= 16.5 (0.2) Girls with low levels of PA enjoyment only	11-week intervention & 3 month study from baseline to post-intervention.	Accelerometry & Accelerometry counts	There was a non-significant smaller decline in participation in PA during school sport for INT group compared to CON group.
4. Fairclough et al. (2005)	Quasi-Experimental Design, England	None specified	n= 26; Mean age= 12.4 (0.4) Girls only study	5-week intervention & 6-week study from baseline to post-intervention.	Direct Observation and HR Monitor & % of lesson time in MVPA	INT group engaged in significantly more MVPA in PE lesson than those in the CON lesson (18.5% vs 13.5%; $p < .05$). INT group engaged in MVPA for an average of 11.9% more lesson time than the CON group.
5. Haerens et al. (2006)	RCT, Belgium	The Theory of Planned Behaviour and The Trans-theoretical Model	n= 1039; Mean age= 13.1 (0.8) Mixed sex study	24-month intervention & 24-month study from baseline to 12 and 24 post-baseline.	Accelerometry and Self-report & Minutes of total PA per day	Time spent in PA of light intensity decreased significantly less for girls in the INT groups (-2 min/day) compared with the CON group (-20 min/day, $p < .05$) at 2 years post-baseline.

6.	How et al. (2013)	RCT, Australia	Self-determination theory	n= 125; Age= Year 8 (13-14 years) Mixed sex study	15-week intervention & 15-week study from pre-intervention to post-intervention	Accelerometry & % of lesson time in MVPA	Girls who chose Option 3 INT group (24.5%; design own lessons based on advice/guidelines) were significantly (both $p < .01$) more physically active for a greater percentage of time than CON (19.1%; standard lesson) and Option 2 INT group (16.5%; 'PE development officer')
7.	Huberty et al. (2014)	Case-crossover Design, USA	None specified	n= 59; Mean age= 11.3 (0.7) Girls only study	12-week intervention & 7/8 month study from baseline to mid-1, mid-2, post-intervention and 3 months follow-up.	Accelerometry & Total MVPA minutes per day	INT group was associated with a statistically significant ($p < .05$) increase in MVPA compared to CON group for girls aged 11-13 years = (1.5 min, 95CI 0.4 to 2.6).
8.	Jago et al. (2012)	Cluster RCT, England	None specified	n= 203; Age= Year 7 (11-12 years) Girls only study	9-week intervention & 5-month study from baseline to time 1 (week 8 or 9) and time 2 (3 months follow-up).	Accelerometry & Weekday MVPA minutes	At time 1 there was a -6.8 difference in MVPA week day minutes for the INT group compare to the CON incentive group (95CI 18 to 4). At time 2 there was an 8.7 difference between INT group compared to CON incentive group (95CI 6 to 12). Wide confidence intervals suggest potential positive but not significant intervention effects.
9.	Jago et al. (2015)	Cluster RCT, England	Self-determination theory	n= 571; Age= Year 7 (11-12 years) Girls only study	8-month intervention & 12-month study from baseline to time 1 (17-20 weeks) and time 2 (52 weeks).	Accelerometry & Weekday MVPA minutes	No evidence that the after school dance programme had any significant effect on weekday MVPA levels, overall PA or PA during the afterschool period. However, during the afterschool period on dance days versus non-dance days' girls obtained 15 minutes more LPA, 4.7 minutes more MVPA and 258 more accelerometer counts.
10.	Jones et al. (2008)	RCT, USA	Social Cognitive Theory and the Trans-Theoretical Model	n= 718; Mean age= 11.6 (0.4) Girls only study must be enrolled in 2 semesters of PE	18-month intervention & 18-month study from baseline to interim-intervention (month 6/7/8) to follow-up (month 18).	Self-report & Total MVPA minutes per day	INT group had higher means for overall total daily minutes of PA and daily MVPA minutes at follow-up compared to CON group. But, only total daily minutes of VPA were significantly higher at follow-up for INT (difference= 6 min, 95% CI = 5.82–6.18, $p = 0.05$) compared to CON. A 45.4% increase in VPA minutes from baseline for INT group (CON= 4.1% decrease).
11.	Loucaides et al. (2009)	Quasi-Experimental Design, Cyprus	None specified	n= 114; Mean age= 11.1 (0.3) Mixed sex study	4-week intervention & 5-6 week study from pre-intervention and 4 weeks post-intervention.	Pedometer & Step count	Small but non-significant increase in mean steps observed during 20-minute break period in INT 2 school 852 (384) to 1004 (525) from baseline to post INT. Compared to slight decreases in both CON 1055 (421) to 962 (466) and INT 1 school 1224 (403) to 1150(339).

12.	Martin & Fairclough (2008)	Quasi-Experimental Design, England	None specified	n= 15; Age= Year 7 (11-12 years) Girls only study	4-week intervention & 8-week study from pre-intervention (1-4 weeks) to post-intervention (week 8).	Accelerometry & % of lesson time in MVPA	Girls engaged in MVPA pre-INT for 29.7% (16.6 min) of lesson time, which increased to 34.9% (19.3 min) during intervention lessons (p<.05).
13.	Pate et al. (2005)	RCT, USA	Social cognitive theory	n= 2744; Mean age= 13.6 (0.6) Girls only study	8-10 month intervention (1 school year) & 12-month study from baseline (spring 8 th grade) to follow-up (spring 9 th grade).	Self-report & 30-minute blocks of MVPA per day	Increases observed in self-reported ≥ two 30 minute blocks of MVPA per day for INT group from baseline to post INT 68.6% to 72.0% but, results were not significant. However, there were significant differences in the percentage of girls who reported regular VPA in the INT group compared to the CON group (44.5% vs 36.4%). A significant increase of 8% (p<.05).
14.	Robbins et al. (2006)	RCT, USA	Pender's Health Promotion Model and the Trans-theoretical Model	n= 77; Age= Grade 6-8 (11-14 years) Low active girls only study	12-week intervention & 12-week study from baseline (week 1) to post-intervention (week 12).	Self-report & Minutes in MPA plus VPA	No differences in self-reported PA between the INT and CON groups. Both the INT group and CON group showed increases in minutes in MPA plus VPA across 2 weekdays and 2 weekend days but these were non-significant.
15.	Robbins et al. (2012)	Quasi-Experimental Design, USA	Pender's Health Promotion Model	n= 69; Mean age= 11.44 (0.7) Girls <MVPA national recommendations only	6-month intervention & 6-month study from baseline to 6 months follow-up.	Accelerometry & Minutes of MVPA per hour	No statistically significant differences in PA levels for minutes of MVPA per hour for the INT or CON group. But, the differences were in the expected direction, with the INT group having slightly higher improvement in minutes of MVPA per hour (0.43) compared to CON group (0.07) from baseline to 6 months follow-up.
16.	Schofield et al. (2005)	Quasi-Experimental Design, Australia	None specified	n= 85; Mean age= 15.8 Low active girls only	12-week intervention & 12-week study from pre-intervention, mid-intervention (week 6) and post-intervention (week 12).	Pedometer and Self-report & Step count	Pedometer INT group significantly increased their total PA (Avg mean daily steps increase of 2747), when compared with the CON group (p<.05) at post-INT.
17.	Spruijt-Metz et al. (2008)	RCT, USA	Self-Determination Theory and the Theory of	n= 459; Mean age= 12.47 (0.6) Girls only study	5-7 day intervention & 6-7 month intervention from baseline (3 months prior to intervention) to follow	Self-report & 30-minute blocks of activity of various intensities	No significant effects on PA of any intensity; VPA, MVPA MPA or LPA. However, the intervention had a significant effect on reducing time spent on SB (p<.05).

		Meanings of Behaviour		up (3 months post-intervention).		
18. Taymoori et al. (2008)	RCT, Iran	Pender's Health Promotion Model and Trans-theoretical model	n= 161; Mean age= 14.79 (0.4) Girls at preparation stage of exercise behaviour change only	6-month intervention & 12-month intervention from pre-intervention to post-intervention (month 6) to 6 month follow-up (month 12.	Self-report & Minutes of total PA per day	TTM and HP group increased mean minutes of PA per day from 27.16 (12.02) at pre-INT to 75.80 (27.52) at post-INT with a slight drop to 60.04 (24.87) at follow-up (both p <.05) compared to CON group. This was similar for the solely HP group increasing from 28.56 (11.30) to 73.61(28.73) at post-INT with a drop to 56.79 (27.58) at follow-up (both p<.05) compared to CON group.
19. Webber et al. (2008)	RCT, USA	Operant Learning Theory, Social Cognitive Theory, Organizational Change Theory and The Diffusion of Innovation Model in a Social-ecologic Framework	n= 3504; Age= Grade 6-8 (11-14 years) Girls only study	36-month intervention & 36-month study from baseline to month 24 post-intervention (staff directed) to month 36 (programme champion) post-intervention.	Accelerometry & Average daily minutes of MET-weighted minutes of MVPA	After the 2 years staff-directed INT, there were no differences (mean= -0.4, 95% CI= -8.2 to 7.4) in adjusted MET-weighted minutes of MVPA between 8 th -grade girls in schools assigned to INT or CON groups. However, significant differences were found between INT and CON groups after an additional year of program champion delivered intervention (INT group 10.9 minutes more MET-weighted MVPA, p<.05).
20. Young et al. (2006)	RCT, USA	Social Action Theory	n= 221; Mean age= 13.8 (0.5) Girls only study must be enrolled in 2 semesters of PE	8-month intervention & 9-month study from baseline to follow-up (month 8 or 9).	Self-report & Estimated total energy expenditure	INT classes spent 46.9% of PE class time in MVPA compared with 30.5% of the time for control classes (p<.001). However, while the INT was successful in increasing MVPA in PE class, no changes were observed in overall, daily, moderate, or hard to very hard mean energy expenditure in either the INT or the CON group.
Notes. CON = Control, INT = Intervention, PA = Physical Activity, SB = Sedentary Behaviour, MVPA = Moderate to Vigorous Physical Activity, VPA = Vigorous Physical Activity, LPA = Light Physical Activity, MPA = Moderate Physical Activity, min = Minutes, PE = Physical Education, TTM = Trans-theoretical Model, HP = Health Promotion, RCT = Randomised Control Trial. For mixed sex studies participant characteristics are shown for girls only.						

3.3.6. Outcome Measures

Five methods were used to measure PA (Table 3.2.). PA was objectively measured with accelerometers in ten studies (Dewar et al., 2014; Dudley et al., 2010; Haerens et al., 2006; How et al., 2013; Huberty et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Martin & Fairclough, 2008; Robbins et al., 2012; Webber et al., 2008), and subjectively measured through self-report questionnaires in nine studies (Bronikowski & Bronikowska, 2011; Dewar et al., 2014; Haerens et al., 2006; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Young et al., 2006). Two studies combined self-report and accelerometers (Dewar et al., 2014; Haerens et al., 2006), one study used pedometers (Loucaides et al., 2009), one study combined pedometers and self-reported PA (Schofield et al., 2005), and one study used heart rate (HR) and direct observation (Fairclough & Stratton, 2005a). Seven out of eight studies published from 2010 onwards utilised accelerometers (Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Huberty et al., 2014; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012; Robbins et al., 2012). Eight out of twelve studies published from 2005 to 2010 used self-reported measures of PA (Haerens et al., 2006; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Schofield et al., 2005; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Young et al., 2006).

Thirteen different units of measurement were used to report a change in PA levels (Table 3.2.). Studies reported percentage of lesson time in MVPA (Fairclough & Stratton, 2005a; How et al., 2013; Martin & Fairclough, 2008), weekday MVPA minutes

(Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Jago et al., 2012), total week MVPA minutes per day (Huberty et al., 2014; Jones et al., 2008), self-reported 30 minute blocks of activity (Pate et al., 2005; Spruijt-Metz et al., 2008), minutes of total PA per day (Haerens et al., 2006; Taymoori et al., 2008), MVPA per hour (Robbins et al., 2012), total MVPA percentage per valid day (Dewar et al., 2014), average daily minutes of MET-weighted minutes of MVPA (Webber et al., 2008), minutes in MPA plus VPA (Robbins et al., 2006), estimated total energy expenditure (Young et al., 2006), accelerometer counts (Dudley et al., 2010), self-reported frequency of weekly leisure-time PA (Bronikowski & Bronikowska, 2011), and step counts (Loucaides et al., 2009; Schofield et al., 2005). As thirteen different units of measurement were used to assess PA, from this point onwards, changes in PA across groups of studies with different units of measurement, will be referred to as 'activity'.

3.3.7. Behaviour Change Theories

Thirteen studies explicitly reported that the interventions incorporated one or more behaviour change theories. These were Social Cognitive Theory (Dewar et al., 2014; Dudley et al., 2010; Jones et al., 2008; Pate et al., 2005; Webber et al., 2008), The Theory of Planned Behaviour (Haerens et al., 2006), Trans-theoretical Model (Haerens et al., 2006; Jones et al., 2008; Robbins et al., 2006; Taymoori et al., 2008), Self-Determination Theory (How et al., 2013; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, Powell, et al., 2015; Spruijt-Metz et al., 2008), Pender's Health Promotion Model (Robbins et al., 2006; Robbins et al., 2012; Taymoori et al., 2008), Theory of Meanings Behaviour (Spruijt-Metz et al., 2008), and The Social Action

Theory (Young et al., 2006). The largest study (Webber et al., 2008) incorporated numerous theories within a socio-ecologic framework, including Operant Learning Theory, Social Cognitive Theory, Organisational Change Theory, and The Diffusion of Innovation Model. One study (Bronikowski & Bronikowska, 2011) used Hellison's Model of Teaching Responsibility through PA. Only five of the studies underpinned by behaviour change theory lasted 12 months or longer. The remaining six studies, which used relatively modest sample sizes ($n \leq 203$) did not specify the use of a behaviour change model or theory (Fairclough & Stratton, 2005a; Huberty et al., 2014; Jago et al., 2012; Loucaides et al., 2009; Martin & Fairclough, 2008; Schofield et al., 2005).

3.3.8. Risk of Bias (Table 3.3.)

Fifteen studies provided outcome data with <20% dropout/withdrawal rates. Thirteen studies employed objective measures of PA, either for the complete sample size or for a sub-sample. Only seven of the included studies described the randomisation processes. Although eleven studies stated a randomisation procedure, the majority ($n=10$) did not provide an explicit explanation of the randomisation process (Bronikowski & Bronikowska, 2011; Haerens et al., 2006; How et al., 2013; Loucaides et al., 2009; Martin & Fairclough, 2008; Pate et al., 2005; Robbins et al., 2012; Schofield et al., 2005; Spruijt-Metz et al., 2008; Webber et al., 2008; Young et al., 2006), which led to their poor randomisation scores. All studies scored weakly for allocation of concealment and/or blinding, with just two studies attempting to blind intervention staff (Jago et al., 2012; Webber et al., 2008). Only one study received a 'very strong' risk of bias score (Jago et al., 2012); three studies received a 'strong' risk of bias score (Fairclough & Stratton, 2005a; Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May,

Kesten, Cooper, Powell, et al., 2015; Webber et al., 2008); ten studies received a 'moderate' risk of bias score (Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Huberty et al., 2014; Jones et al., 2008; Loucaides et al., 2009; Martin & Fairclough, 2008; Robbins et al., 2006; Robbins et al., 2012; Taymoori et al., 2008), six studies received a 'weak' risk of bias score (Bronikowski & Bronikowska, 2011; Haerens et al., 2006; Pate et al., 2005; Schofield et al., 2005; Spruijt-Metz et al., 2008; Young et al., 2006).

Table 3.3. Risk of bias assessment

	Study	Appropriate sequence generation and/or randomisation	Allocation concealment and/or blinding	Complete outcome data and/or low withdrawal /drop-out	Appropriate outcome measure (PA)	Risk of Bias Score
1.	Bronikowski et al. 2011			X		*
2.	Dewar et al. 2014	X			X	**
3.	Dudley et al. 2010	X			X	**
4.	Fairclough et al., 2005	X		X	X	***
5.	Haerens et al. 2006				X	*
6.	How et al. 2013			X	X	**
7.	Huberty et al. 2014			X	X	**
8.	Jago et al. 2012	X		X	X	***
9.	Jago et al. 2015	X	X	X	X	****
10.	Jones et al. 2008	X		X		**
11.	Loucaides et al. 2009			X	X	**
12.	Martin et al. 2008			X	X	**
13.	Pate et al. 2005			X		*
14.	Robbins et al. 2006	X		X		**
15.	Robbins et al. 2012			X	X	**
16.	Schofield et al. 2005				X	*
17.	Spruijt-Metz et al. 2008			X		*
18.	Taymoori et al. 2008	X		X		**
19.	Webber et al. 2008		X	X	X	***
20.	Young et al. 2006			X		*

3.3.9. Meta-analysis

Of the 20 studies included in the narrative synthesis 17 provided sufficient data for inclusion in the meta-analysis. Huberty et al. (2014) was excluded for not reporting sample size, Martin and Fairclough (2008) did not use a control group and Webber et al. (2008) did not report variance of data. Cohen's (1988) effect size criteria were used to interpret the overall treatment effect for the main analysis and subgroup analyses. Of the 17 included studies, 12 reported a small effects ($g = -0.29$ to 0.26), four studies reported moderate to strong effects ($g = 0.65$ to 1.04) and one reported a very strong effect size ($g = 3.43$) (Taymoori et al., 2008). The meta-analysis revealed a significant small positive treatment effect ($k=17$, $g = 0.37$, $p<.05$,) for school-based PA interventions for adolescent girls (Table 3.4.). Heterogeneity analysis indicated significant between-study variance ($Q = 80.12$, $p<0.001$; $I^2 = 94.91\%$). The Taymoori et al. (2008) intervention was identified as an outlier due to large residual effects ($z = 7.61$). Once this study was removed the average treatment effect was significantly reduced by 0.30, indicating a very small positive effect which approached significance ($k = 16$, $g = 0.07$, $p = .05$) (Figure 3.2.). Heterogeneity was also substantially reduced when the outlier was removed ($Q = 23.98$, $p = 0.05$; $I^2 = 0.01\%$).

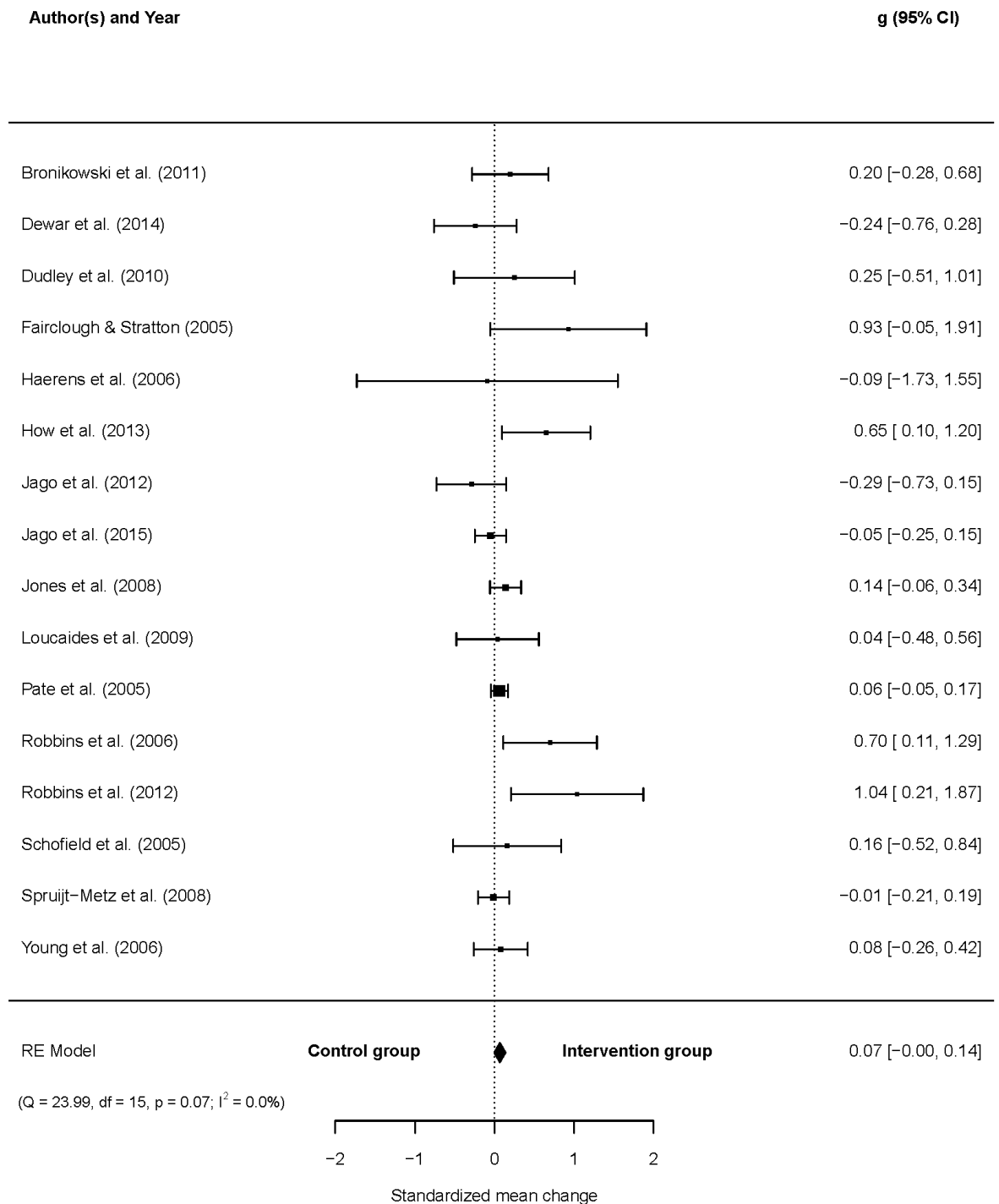


Figure 3.2. Forest plot with outlier removed (k= 16). Graph depicts effect size and 95% CI for individual studies and the pooled estimate.

Inspection of the funnel plot for publication bias indicated asymmetry. The trim and fill procedure added 3 studies to the left side of the plot which reduced the overall treatment effect by 0.01. Orwin's fail-safe N calculation suggested that there would need to be 16 unpublished studies to reduce the treatment effect to a target effect size of $g = 0.11$, and Egger's regression test was significant ($z = 2.07$, $p < .05$). Collectively, these results indicated a high probability of publication bias.

Although heterogeneity from the pooled analysis was low, the individual effects from the included studies were extremely inconsistent, ranging from $g = -0.29$ to 1.04 . Thus, subgroup analyses were performed as planned to explore whether the identified subgroups moderated the average intervention effect (Table 3.4.). The identified outlier study was removed from the relevant subgroups in all analyses. Significant effects were observed for studies with * or ** bias ratings ($k = 13$, $g = 0.09$, $p < .05$), for multi-component interventions ($k = 7$, $g = 0.09$, $p < .05$), and for interventions underpinned by theory ($k = 12$, $g = 0.07$, $p < .05$) but the magnitudes of these were small (Table 3.4.). Subgroup analyses also revealed no effect for whether the interventions were targeted at girls only or mixed-sex, although only 3 mixed sex studies were included.

Table 3.4. Sub-group analyses

Subgroup Variables	Effect size statistics				Null test	Heterogeneity statistics		Publication bias
	k	g	SE	95%CI	Z	Q	I ²	Eggers' z
Pooled Effect	17	0.37	0.19	0.0008, 0.73	1.96*	80.12**	94.91%	2.05*
Pooled Effect ‡	16	0.07	0.04	-0.002, 0.14	1.92=	23.98	0.01%	2.07*
Measurement Method								
Objective	10	0.16	0.14	-0.11, 0.43	1.14	17.92*	55.62%	1.71
Self-report ‡	6	0.08	0.04	-0.002, 0.16	1.92=	5.81	0.04%	1.57
Study Duration								
Short (<6 months)	8	0.22	0.14	-0.06, 0.50	1.53	15.01*	56.92%	1.75
Long ‡ (>6 months)	8	0.06	0.04	-0.02, 0.14	1.51	8.84	0.00%	0.76
Risk of Bias								
* or ** ‡	13	0.09	0.04	0.02, 0.17	2.37*	16.67	0.00%	1.93=
*** or ****	3	0.01	0.23	-0.44, 0.46	0.05	4.99	65.95%	1.30
Study Design								
Single	9	0.02	0.06	-0.09, 0.14	0.41	11.83	0.00%	2.13*
Multi ‡	7	0.09	0.04	0.006, 0.18	2.09*	11.30	0.02%	1.47
Theory Included								
Yes ‡	12	0.07	0.04	0.0009, 0.15	1.98*	18.35	0.01%	2.11*
No	4	0.06	0.20	-0.33, 0.45	0.31	5.38	38.75%	2.25*
INT Gender Target								
Girls Only ‡	13	0.06	0.04	-0.02, 0.13	1.53	19.35	0.03%	1.61
Mixed	3	0.28	0.17	-0.05, 0.61	1.65	2.64	20.27%	0.92

Note. ‡ Outlier removed from subgroup. k = number of effect sizes. g = effect size (Hedges' g). SE = standard error. 95%CI = confidence intervals (lower limit, upper limit). Z = test of null hypothesis. Q = test of variance between effects sizes. I² = total variance unexplained by moderator. Eggers' z = test of publication bias.
 = p equal to 0.05
 * p<0.05
 ** p<0.001

The three studies excluded from the meta-analysis all indicated positive results. Huberty et al. (2014) found that on the days the after school club was delivered the intervention group significantly increased MVPA by 1.5 minutes compared to the control group (non-afterschool club). Martin and Fairclough (2008) found that girls increased their percentage of lesson time MVPA by 5.2% (2.7 minutes) from non-intervention lessons to intervention lessons. Webber et al. (2008) found no significant differences after 2 years of the staff directed intervention. However, after a further year of programme champion delivered intervention, girls had significantly more MET-weighted minutes of MVPA (10.9) compared to girls in the control school.

3.4. Discussion

This systematic review and meta-analysis examined the effect of school-based PA interventions on PA outcomes among adolescent girls. The meta-analysis results indicate that school-based PA interventions have only a very small effect on adolescent girls' PA levels. Some individual studies showed positive results and the subgroup analyses revealed promise for approaches underpinned by theory and multi-component interventions. Although school-based interventions have been suggested as being the most promising setting to intervene with adolescent girls (Camacho-Minano et al., 2011; Pearson et al., 2015), the observed small effect illustrates the difficulties and challenges of positively impacting adolescent girls' PA behaviours through the school setting. These difficulties may in part be due to a number of factors such as, social or cultural norms, ability to provide a wide range of PA opportunities, short-term intervention periods, PA measurement methods, and small sample sizes, which precluded the detection of significance.

Although subgroup analysis inferred a significant effect for interventions underpinned by behaviour change theory, this was a very small effect. This is consistent with findings from a recent review investigating the effectiveness of after-school PA interventions to increase MVPA (Mears & Jago, 2016). It was reported that a lack of convincing evidence exists that interventions underpinned by theory were more effective than those with no specified theory (Mears & Jago, 2016). The lack of a clear link between reported theoretical design and effectiveness could also be due to the implementation of the theories within the interventions. Few studies reported theoretical fidelity, which precludes direct inferences being made between

intervention effectiveness and underpinning theory. To address this, future studies need to illustrate the direct links from theory to implementation as poor implementation of the theory could be contributing to the lack of success in some interventions (Naylor et al., 2015). The recently proposed Theory of Expanded, Extended, and Enhanced Opportunities (TEO) could provide a more practical and PA-specific theory to implement in school-based PA interventions, which is not clearly present in any of the reviewed interventions, and warrants further exploration (Beets et al., 2016). This theory can be used in conjunction with other more traditional behaviour change theories but helps provide a more PA-specific framework, to increase PA opportunities within the school setting.

Multi-component interventions were also found to have small significant effects. School-based multi-component interventions are well supported as effective approaches to impact adolescent PA levels (Kriemler et al., 2011; Pearson et al., 2015; Van Sluijs et al., 2007). Multicomponent intervention designs are consistent with the concept of Comprehensive School PA Programmes (CSPAPs), which are recommended as effective strategies to increase young people's PA (Centers for Disease Control and Prevention, 2013; World Health Organisation, 2010). CSPAPs are multicomponent in nature, aiming to intervene through PE, before and after school PA, during school PA, staff involvement, and family and community engagement. Using the CSPAP model as a form of comprehensive multicomponent intervention to target adolescent girls, integrated with an appropriate research design, may be a promising approach for future intervention efforts (Carson, Castelli, Beighle, & Erwin, 2014; McMullen, Ní Chróinín, Tammelin, Pogorzelska, & van der Mars, 2015).

Modified PE lessons were commonly used as single component interventions or as part of multicomponent interventions, and were effective in significantly increasing lesson time PA (Bronikowski & Bronikowska, 2011; Fairclough & Stratton, 2005a; How et al., 2013; Martin & Fairclough, 2008). This supports previous research which has shown the impact of modified PE lessons designed to increase MVPA, with students engaging in 24% more MVPA during modified PE compared with students in usual PE practice conditions (Lonsdale et al., 2013). Similarly, Camacho-Minano et al. (2011) suggested that school-based interventions are more effective when enjoyment of PE is prioritised and girls are given freedom of choice of activities. Enjoyment has been found to partially mediate the positive effect of modified PE interventions (Dishman et al., 2005), which further emphasises the importance of choice and enjoyment within school-based interventions for adolescent girls. This reinforces the importance of autonomy-supportive teaching principles such as, the Supportive, Active, Autonomous, Fair, Enjoyable (SAAFE) framework (Lubans et al., 2017). This evidence based framework encourages teachers to provide students with opportunities for autonomy during PA sessions to support the promotion of more activity during sessions (Lubans et al., 2017). However, PE occurs infrequently within schools (usually 1-2 hours per week) and accounts for only a very small percentage of weekly waking hours, therefore its impact on total daily MVPA is limited.

The current review reveals a shift in the last seven years in school-based PA interventions for adolescent girls towards objective measurements of PA rather than subjective measures. Specifically, accelerometers were the preferred method of measurement, in 7 out of 8 studies conducted since 2010. The use of accelerometer-

based measures allows for a more accurate assessment of PA intensity (Butte, Ekelund, & Westerterp, 2012; Cain et al., 2013; De Vries et al., 2009). However, accelerometers provide no contextual information such as, who girls are doing activity with and what activity they are doing, which is valuable in social and fluid environments like schools. Moreover, issues such as waterproofing and wear site preclude adequate assessments of some movement modes such as, swimming or cycling (Dollman et al., 2009). Additionally, accelerometers have been found to have poor wear compliance in PA studies with adolescents (Borde, Smith, Sutherland, Nathan, & Lubans, 2017). Few included studies utilised focus groups or interviews with participants post-intervention. Understanding the context for PA through these measurement methods may help researchers and practitioners to truly assess the effectiveness of interventions and refine and amend interventions.

Risk of bias scores did not appear to be associated with intervention effectiveness. Studies that scored poorly (* or **) for risk of bias showed a small significant effect in subgroup analyses. Risk of bias scores were low across the included interventions mainly due to the need for a greater explanation of the randomisation process which is consistent with a previous systematic review of adolescent girls (Camacho-Minano et al., 2011). Thus, poor scores may have been due to poor reporting rather than poor methodological design. Without a detailed explanation of the randomisation process, it could not be confirmed that the groups were truly distributed randomly (Higgins & Green, 2011). As found in previous reviews, both for PA interventions for adolescents (Camacho-Minano et al., 2011) and school-based behavioural interventions (Khambalia, Dickinson, Hardy, Gill, & Baur, 2012), allocation concealment and blinding

were usually absent, and this negatively affected the risk of bias scores for the majority of included studies. The majority of studies showed low withdrawal and dropout rates (<20%) which is positive considering the range of participant numbers and measurement methods reported. This could be due to the structure a school environment provides and the influence schools have on girls of this age (Kohl III & Cook, 2013).

3.4.1. Strengths and Limitations

To our knowledge, this is the first systematic review to combine girls-only and mixed-sex school-based PA interventions (2005 onwards) to assess their effectiveness for adolescent girls. Twenty one studies were excluded from the final synthesis because the authors did not respond to requests to provide PA data by gender within the 7-day timescale allowed. This limited response time is a limitation as this data potentially could have doubled the number of included studies, and interaction by sex tests were not explored for these studies. The inclusion of all study types, including feasibility and pilot studies, may have impacted the overall findings of the review as these tended to be smaller scale projects with small sample sizes. Where multiple primary PA outcomes were reported we used MVPA or MPA wherever possible to maintain relevance to PA guidelines. However, there were instances where alternative PA outcomes were also included (e.g., steps, accelerometer counts).

3.4.3. Conclusion

The meta-analysis indicated a small but significant positive effect of school-based interventions on adolescent girls' PA. Sub-group analyses indicated small but

significant effects for multicomponent interventions and interventions underpinned by theory. The recent trend towards the objective measurement of PA within the school setting with accelerometry data should continue. It is important that future research and policy makers continue to recognise the school environment as a vehicle for changing girls' PA levels with an emphasis on multicomponent interventions underpinned by theory.

Chapter 3 Conclusion

Although school-based interventions are widely viewed as the most promising strategy to increase PA in adolescent girls, this review article highlights that school-based interventions have only a small impact on adolescent girls' PA levels. The review article highlights that interventions that are underpinned by theory and multi-component in design lead to more positive effects. This finding informs the development of a novel school-based intervention discussed further in Chapter 5. This systematic review and meta-analysis demonstrates the difficulties of increasing PA with adolescent girls. Further investigation and the development of novel school-based approaches should be encouraged, appropriately designed and evaluated in an attempt to find new methods to increase PA levels in adolescent girls.

Thesis Study Map

Study	Objectives and Key Findings
Study 1 - The Effectiveness of School-Based Physical Activity Interventions for Adolescent Girls: A Systematic Review and Meta-analysis	Objectives <ul style="list-style-type: none"> - Assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. - Systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis.
	Key Findings <ul style="list-style-type: none"> - The meta-analysis indicated a small but significant positive effect of school-based interventions on adolescent girls' PA. - Sub-group analyses indicated small but significant effects for multicomponent interventions and interventions underpinned by theory.
Study 2 - Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls Peer Activity (G-PACT) Intervention Study	Objectives <ul style="list-style-type: none"> - Qualitatively explore adolescent girls' understanding of PA - Explore adolescent girls' experiences of and perceptions towards engagement in school-based PA. - Explore adolescent girls' beliefs about factors important to facilitate PA engagement.
Study 3 - The Feasibility of a Novel School Peer-led Mentoring Model to Improve the Physical Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project	

Study 4 - The Feasibility
and Acceptability of The
Girls Peer Activity (G-
PACT) Peer-led
Mentoring Intervention

Chapter 4

Study 2: Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls Peer Activity (G-PACT) Intervention Study



GIRLS PEER ACTIVITY

A manuscript reporting main outcomes of this study has been submitted to the *Journal of School Health* and is currently under peer review:

Owen, M. B., Kerner, C., Newson, L., Noonan, R., Curry, W. B., Kosteli, M. C., & Fairclough, S. J. (*In Review*). Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls' Peer Activity (G-PACT) Intervention Study. *Journal of School Health*.

4.1. Introduction

There are multiple psychosocial factors which influence adolescent girls' engagement in PA including perceived competence, self-efficacy, motivation, peer support, perceived barriers and enjoyment (Craggs, Corder, Van Sluijs, & Griffin, 2011; Laird et al., 2016; Sterdt et al., 2014). Psychosocial PA influences can be location-specific. For example, peer support, enjoyment and perceived competence have been found to be significant influences on before, during and after-school PA (Ommundsen et al., 2006). Enjoyment of PA has been found to mediate the impact of previous school-based PA interventions among adolescent girls, with increased enjoyment leading to increased PA levels (Dishman et al., 2005). When interventions target girls with lower levels of PA enjoyment this increase in PA levels can be more pronounced (Schneider & Cooper, 2011).

Engaging with adolescent girls to explore their current PA school-based behaviours, perceived PA competence, PA peer support, and PA enjoyment could identify areas for school PA improvements and targeted interventions. This exploratory study was used as a formative assessment (Craig et al., 2008), to inform the development and

design of a physical activity intervention as part of the Girls Peer Activity (G-PACT) project. The primary aim of this study was to explore adolescent girls' perceptions and experiences of school-based PA and PA development opportunities within the school setting. The study objectives were to qualitatively explore adolescent girls' (a) understanding of PA, (b) experiences of and perceptions towards engagement in school-based PA, and (c) beliefs about factors important to facilitate PA engagement.

4.2. Methods

There were three components to the exploration study: (1) a questionnaire to assess adolescent girls' current PA levels, (2) an open-ended questionnaire investigating girls' perceptions and experiences of PA, and (3) focus groups exploring girls' perceptions and experiences in greater depth.

4.2.1. Participants

Theoretical sampling was used to ensure the exploration was focused on the section of the population that provided the most meaningful information relative to the research aims and objectives (Strauss & Corbin, 1998). One hundred and ten adolescent girls (mean age = 14.26, SD = 0.03 years) from a school in an area of low-deprivation (McLennan et al., 2015) in the West Lancashire region of England, were recruited to the study. The school's PE teachers initially presented an overview of the study and invited the students to participate. Following the questionnaire phase a sample of girls ($n = 30$) were selected to participate in the focus group sessions. Ethical approval was granted from the Faculty of Arts and Sciences Research Ethics Committee at Edge Hill University (SPA-REC-2016-340).

4.2.2. Instruments

The Youth Physical Activity Profile (YAP) (Saint-Maurice & Welk, 2014) was used to identify the adolescent girls' overall PA levels. This questionnaire has been validated and calibrated against an objective method to provide a reliable estimate for youth moderate to vigorous PA and sedentary behaviour levels at group level (Saint-Maurice & Welk, 2015). The YAP contained 15-items scored on a 1-5 Likert scale with three sections each containing five questions relating to; school-based PA, out of school PA, and sedentary habits out of school over the previous 7 days.

The open-ended questionnaire was designed by the research team to gain insight into girls' perceptions and experiences of school-based PA. The questionnaire contained 6 questions closely linked to PA correlates for adolescent girls (Sterdt et al., 2014) and related to knowledge about PA, enjoyment of PA and friend's engagement with school-based PA.

The focus groups were used to explore participants' in-depth perceptions and experiences of school-based PA opportunities including PE and after-school PA clubs. Focus groups are commonly used with adolescent girls and help provide a comprehensive understanding of their PA behaviours (Mitchell, Gray, & Inchley, 2015; Slater & Tiggemann, 2010; Whitehead & Biddle, 2008). The focus groups were facilitated by two trained researchers (MO & CK) with experience in conducting focus groups with adolescents. A short icebreaker activity was used preceding the focus group to build rapport with the adolescents as the researchers were older (> 10 years) and one was a male. The focus groups were semi-structured in nature and lasted between 25-40 minutes. The focus group questions related to perceived benefits,

perceived barriers, self-efficacy, and were linked to correlates of adolescent girls PA (Sterdt et al., 2014) and future intervention design. Participants were informed that the focus groups would be audio-recorded but individual responses to questions would not be shared or reported back to their teachers. However verbatim quotations may be used in the analysis, with any personal identifiable material removed or anonymised (e.g. names replaced with pseudonyms).

4.2.3. Procedure

All participants were provided with a brief overview of the study and provided assent to complete the YAP. One hundred and ten participants completed the YAP using school iPads at the start of a PE lesson under the supervision of trained researchers. One week later, girls across various PA levels were asked to complete the open-ended questionnaire using the same procedure stated above.

The YAP data was checked and collated. Participants scores were stratified into quintiles which represented their overall PA habits, ranging from low (quintile 5) to high active (quintile 1). Ten girls from each of the low, mid and high active groups were then randomly selected, and invited to participate in focus groups to discuss their PA behaviours. From the 30 girls invited to participate, eight provided written parental consent and assent and these were categorised as a high active group (HA, $n = 4$) and a low-to-mid active (LMA, $n = 4$) group. Both groups received the same semi-structured focus group questions. All participants were given the opportunity to respond to each question and additional discussion developed from the responses provided by participants.

4.2.4. Data Analysis

4.2.4.1. PA Questionnaire (YAP)

Mean scores were created for each of the 3-sections of the questionnaire to provide an overview of the girls PA and sedentary behaviour habits. The 2-sections (10 questions) relating to PA provided an overall mean PA score for each participant. As stated above, this mean individual PA score was used to purposefully select participants to partake in the focus groups.

4.2.4.2. Open-ended Questionnaire

All free-text responses from the online open-ended questionnaire were analysed through conceptual content analysis (Weber, 1990) to provide an overview of adolescent girls' thoughts and perceptions. Frequency tables were created for the open-end questionnaire responses to illustrate the frequency of responses.

4.2.4.3. Focus Groups

Audio-recordings from the focus groups were transcribed verbatim. Inductive thematic analysis of the data was completed using a step-by-step guide set out by Braun and Clarke (2006); (1) familiarising yourself with your data, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. An inductive analysis allowed for the exploration of unanticipated findings. To ensure methodological rigour, credibility, and trustworthiness (Nowell, Norris, White, & Moules, 2017) steps 2-5 were also completed by a second author (MCK), any disagreements were discussed until a

consensus was reached. Triangulation of data was achieved through comparison of the open-ended questionnaire and focus group data (Carter, Bryant-Lukosius, DiCenso, Blythe, & Neville, 2014).

4.3. Results

4.3.1. PA data

One hundred and ten girls completed the YAP (Age = 14.26, SD = 0.30 years). The YAP revealed that the participants engaged in more activity at school compared to out of school. The overall YAP scores ranged from 1.3 – 2.9 for the LMA group and 3.9 – 4.6 for the HA group.

4.3.2. Open-ended Questionnaire data

Fifty-two participants fully completed the open-ended questionnaire.

Understanding of PA

Participants showed a limited understanding of importance of PA and the health benefits (Figure 4.1.). This understanding related to physical benefits of PA rather than wider social or psychological benefits.

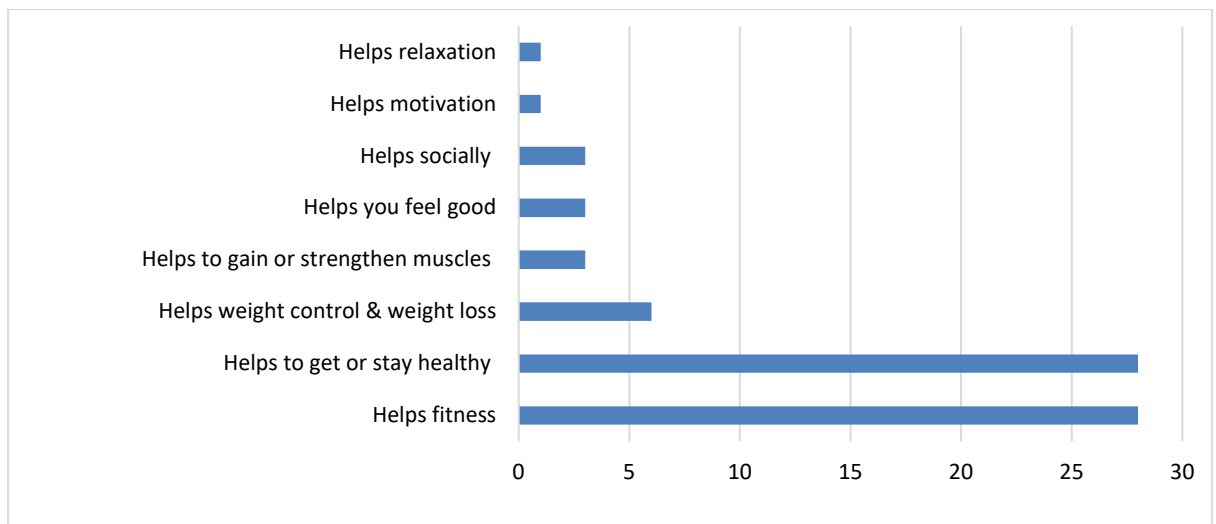


Figure 4.1. Frequency Count of Adolescent Girls' Responses on Their Understanding of the Benefits of PA

Enjoyment of PA

For participants who reported enjoyment of PA, 46% recorded the main reason they enjoyed PA was because it was fun, with 23% reporting that they enjoyed PA because it helps with fitness and feeling healthier. Some participants reported they were unsure as to whether they enjoyed PA, as it was dependent on the type of activity they were doing.

Enjoyable Activity with Friends

Tennis was reported as being the most enjoyable activity to do with friends closely followed by running and rounders (Figure 4.2.).

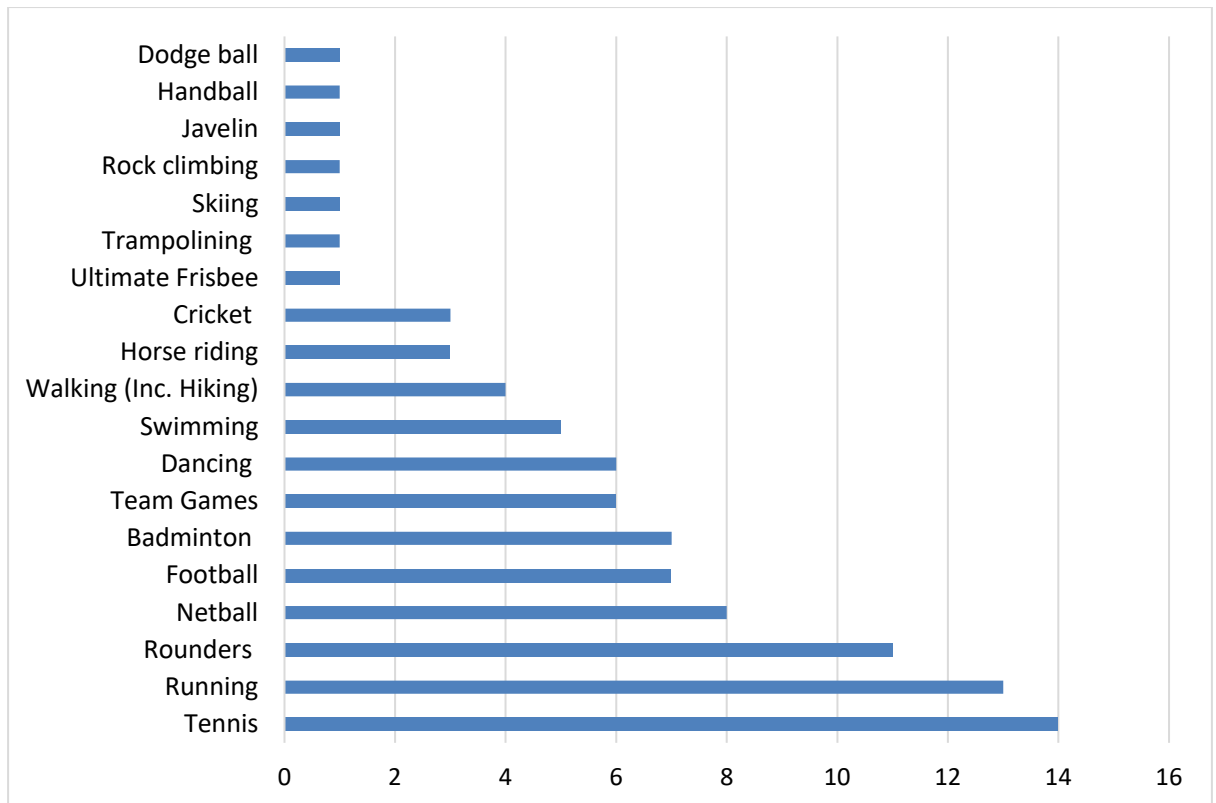


Figure 4.2. Frequency Count of Adolescent Girls' Responses on the Most Enjoyable Physical Activities to do With Friends.

Friends' Engagement with School-based PA

Only 7 participants provided responses as to why their friends engaged with current school-based physical activities. The main reason given for their friends attending school-based PA sessions was enjoyment (fun) (Figure 4.3.).

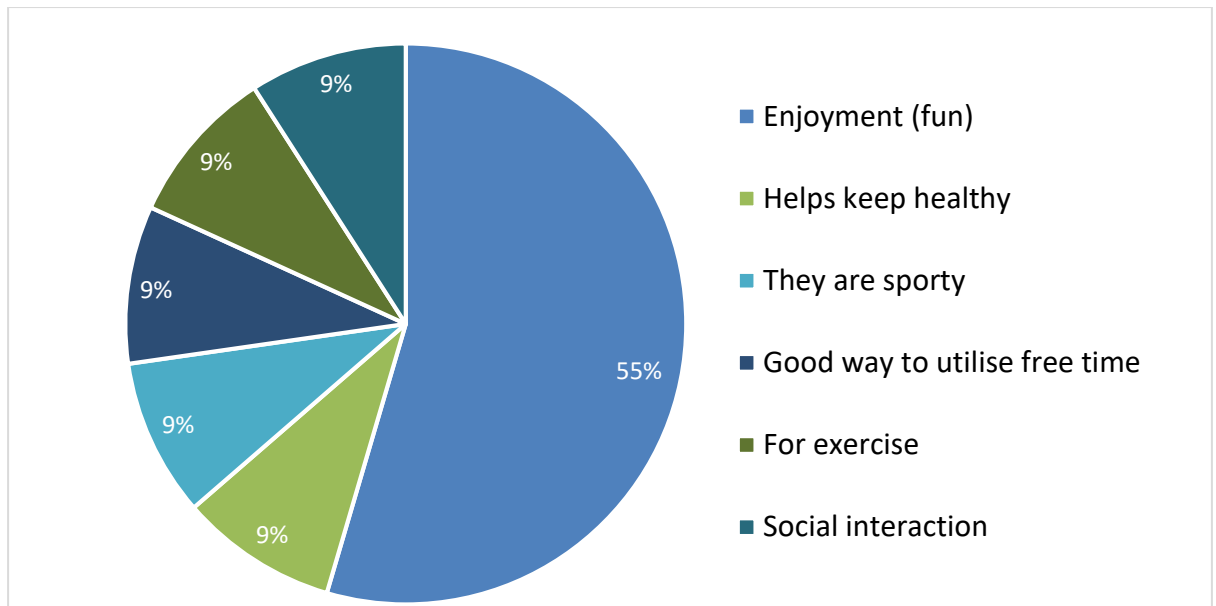


Figure 4.3. Frequency Count of Adolescent Girls' Responses on why Their Friends Engage in School-Based PA

A higher proportion of responses focused on why their friends do not attend school-based PA sessions ($n = 46$). The main reasons stated were, too busy to attend, lack of motivation, not sporty, and lack of options (Figure 4.4.).



Figure 4.4. Frequency Count of Adolescent Girls' Responses on why Their Friends do not Engage in School-Based PA

4.3.3. Focus Group data

4.3.3.1. LMA group

The master themes for the LMA group were non-competitive activities and after-school sport culture.

Non-competitive Activities

When given the freedom to choose physical activities that they would like to do within the school setting participants reported the desire for more non-competitive activities. Specifically, participants reported that these non-competitive activities were more enjoyable and there was less pressure on performing or winning.

“R2: probably a team sports like rounders ... so like everyone is involved

I: ... ok so team sports and rounders, why rounders?

R1: because even if you miss it, nobody’s bothered because you could be really good and miss it. If you don’t hit it, you still run anyway, so you are not out straight away” (LMA, R2 & R1, P.3, L.64-68)

Skill level not being the priority of the activity appealed to participants. Participants identified a desire for the provision of more non-competitive activities. They stated that non-competitive opportunities could focus on improved competence but should avoid the primary focus of these activities being on winning or losing. Participants suggested doing activities for enjoyment and no pressure being placed on performance.

After-school Club Culture

Participants reported the current after-school clubs as being for school teams only and that the same people go to these clubs on a regular basis.

“We have after-school clubs like netball or cricket, but usually it is just the same people who do that” (LMA, R1, P.5, L.155)

They viewed the after-school clubs as having a membership process where certain requirements and qualities were needed to attend. For example, only girls who were highly competent and in the school teams went to the after-school clubs and they have always gone to these clubs.

“It just seems to be the schools teams are more or less the same people” (LMA, R4, P.6, L.163)

Participants that did not go to the clubs were fearful of attending because they would not fit in or lacked sporting competence and they displayed low levels of self-efficacy.

“I wouldn’t like to go because everyone is really good ... I don’t think I’d be good enough to go” (LMA, R3, P.9, L.261)

Participants indicated a lack of teacher encouragement for the lower skilled girls, while girls with higher sporting competence were actively recruited to attend the sessions. The participants suggested separate after-school clubs sessions for school teams and separate ‘fun’ sessions to encourage more girls to attend.

“They could do practices for people who are actually in the team and one for fun separately, otherwise you can feel like you are intruding on the team practice” (LMA, R3, P.9, L.277)

The type of activity was mentioned as being a crucial factor to friends and peers attending the sessions, which linked to the desire for non-competitive activities.

3.3.2. HA group

The master themes for the HA group were PA perceptions and PE.

PA perceptions

HA participants perceived PA as an activity that was done for fun and because they enjoyed it. They linked physical activities to working as a team and being active with friends.

“Being with your friends, it makes it more fun ... it’s more enjoyable when you’re like having fun with it” (HA, R2, P.2, L.54)

HA participants perceived PA to be more fun when it was done with friends. Additionally, the HA participants perceived certain forms of PA as an opportunity to compete with their friends, which motivated their PA behaviours.

“R1: I like the competitive side of it as well... so if you want to win at something you put like maximum effort into it...”

R4: Well... Like if you get to do it with your friends, it like motivates you, to get better... So, like if one of your friends is like better at something you’d want to get better as well” (HA, R1 & R4, P.2, L.58)

Participants reported the desire to want to win and needing to give maximum effort to beat their friends. These participants also reported engagement with sports teams outside of school for hobbies.

Physical Education

The HA participants identified a preference towards ‘sporty’ children in their PE lessons which was linked to grouping and interactions with teachers. Participants reported that less active peers felt uncomfortable in PE with some peers being ‘forced’ to engage in the activities.

“I think favouritism is a big thing in PE my sister has told me that I get favouritised because I do a lot of sport over someone who doesn’t do a lot of sport ... some people dread going to PE because they noticed because they don’t have any interest in sports and they are forced to do it among people who do like to do it”
(HA, R3, P.7, L.199)

Having greater autonomy within PE was identified by the HA participants as a method to increase participation and enjoyment for their peers.

“I: How do you think that could be improved for those people that don’t like it?”

R1: Choice

R3: Choice

R2: If they were able to pick what they want to do they would have more interest in it” (HA, R1, R3, & R2, P.7, L.209)

Participants reported suggestions to engage peers in PE lessons and other school-based PA programmes, regardless of activity level or sporting competence. Grouping with friends and having a level of autonomy over the activities were noted as key components for themselves and their peers. One example given is the utilisation of circuit training for fitness.

“A circuit training one which is more like a fitness thing... so they could go more for themselves rather than competitive sports, as that might be why they don’t like it because they don’t want to compete with anyone, because they know they are not very good at it” (HA, R3, P.8, L.248)

They suggested a focus on individual improvement rather than competition between peers being the focus to after-school clubs to increase participation and retention.

4.4. Discussion

The primary aim of the study was to explore adolescent girls' perceptions and experiences of school-based PA and investigate how school-based PA opportunities could be developed. The exploration study revealed differences in perspectives of school-based PA based on participants' overall level of PA. Girls with lower levels of activity appeared to enjoy, and desire more non-competitive PA opportunities within the school setting. Whereas, higher active girls enjoyed the competitive elements of PA. Regardless of activity level, participants gained greater enjoyment from PA when participating with friends and having greater autonomy over activity within the school setting. Girls with lower levels of PA perceived the after-school club environment as being for sporty girls only and there is a certain sporting competence required to attend.

It is well established that enjoyment of PA is positively correlated with PA participation levels for adolescents (Dishman et al., 2005a). The findings indicate a desire for greater enjoyment within school-based PA, especially for LMA girls. One method to achieve this would be through greater autonomy through freedom of choice during school-based PA opportunities. Researchers have shown that through increased choice of activities, girl only classes, inclusion and small group interaction, girls' enjoyment of PE was higher and their daily levels of PA were higher (Dishman et al., 2005b). Similarly, making PE more enjoyable for adolescent girls and increasing the amount of activity choice and non-competitive opportunities were central to increasing girls PA

in previous school-based interventions (Jamner et al., 2004; Story, Sherwood, Himes, Davis, Jacobs, Cartwright, Smith, et al., 2003; Young et al., 2006). This suggests that for the G-PACT project, the provision of an array of non-competitive opportunities for adolescents to choose from may be useful to increase adolescent girl's enjoyment and engagement in school-based PA.

Based on adolescent girls' desire for greater autonomy, peer support and enjoyment, the Self-Determination Theory (SDT) (Ryan & Deci, 2000) provides an appropriate structure to formulate future interventions and school-based programmes with this population. According to the SDT increasing girls' three basic psychological needs (autonomy, relatedness and competence) could lead to greater intrinsic motivation and enjoyment of PA and thus, greater engagement with PA in the school setting. A recent study based on the SDT found that positive changes in PA were associated with increases in autonomous motivation (Quaresma, Palmeira, Martins, Minderico, & Sardinha, 2015). Additionally, Mitchell, Gray, et al. (2015) found that when the girls were consulted about PE and offered a choice of activity, this led to increased participation and more positive perceptions of the subject. This intervention created a more needs supportive environment for disengaged adolescent girls leading to attitude and behaviour changes (Mitchell, Gray, et al., 2015). This approach may be particularly useful when targeting LMA girls in the G-PACT project.

The LMA reported the afterschool club culture, which directly relates to their perceived barriers to PA. Girls' lack of PA knowledge, as found in the open-ended questionnaire responses and focus groups, illustrates a gap in knowledge and understanding potentially influencing their perception on the benefits of PA. The

importance of enjoyment to adolescent girls in relation to PA engagement highlights the need for enjoyable opportunities (cues to action) being provided within the school setting.

The current findings are further supported by qualitative work by Brooks and Magnusson (2007), who reported lack of enjoyment due to less choice in PE and greater enjoyment during activities in which they felt they have more control and choice over. Providing girls with choice and control is not always possible in fluid environments such as schools. Physical resources and teacher expertise can restrict the provision of choice but, negotiating the curriculum and giving adolescent girls a voice is crucial to their engagement in PE and PA (Enright & O'Sullivan, 2010). Additionally, the degree to which teachers support girls' PA autonomy compared to attempting to control their behaviour, has been found to be a strong influence on PA engagement (Ryan & Deci, 2006).

It should be noted that PA is a complex multi-dimensional behaviour which is influenced by several psychological, biological, environmental and socio-cultural factors (Sterdt et al., 2014). This exploration study primarily focused on intrapersonal and interpersonal factors (i.e. perceived competence, enjoyment and peer support) but, organisational and environmental factors such as the school structure and setting also play a key role in girls' PA behaviours (Eime et al., 2015; Humbert et al., 2008). Similar to previous research (Fairclough et al., 2012) this exploration study found that girls are more active in school than out of school, providing support for the structure of the school day positively influencing PA behaviours (Brazendale et al., 2017).

The school environment helps provide a peer supportive environment for the promotion of PA (Humbert et al., 2008; Kirby, Levin, & Inchley, 2011; Mitchell, Gray, et al., 2015). Girls, regardless of PA level, depict a strong preference towards doing PA with their friends, which was related to greater PA enjoyment and engagement. Peer support has been found the increase in importance throughout adolescence (Kirby et al., 2011), result in higher levels of total and discretionary MVPA (Morrissey, Janz, Letuchy, Francis, & Levy, 2015) and is consistently associated with smaller declines in PA (Craggs et al., 2011). Therefore, it is clear that peer groupings within the school setting are very important to perceptions, experiences and engagement of school-based PA for adolescent girls (Kirby et al., 2011).

Intrapersonal factors such as perceived health benefits and perceived competence have been identified as being vital to increase PA in adolescent girls (Humbert et al., 2008) yet, the current study shows a limited understanding of the health benefits for adolescent girls. This could be an important area for future interventions to target. The current study highlighted that LMA girls felt hindered by their perceived sporting competency to attend after-school PA opportunities. Girls' perceptions of their own competency have been found to be a barrier to PE participation (Inchley, Kirby, & Currie, 2011). During the transition from adolescence to adulthood, perceived sports competency has been found to be positively associated with being continuously active (Jose, Blizzard, Dwyer, McKercher, & Venn, 2011). Interventions, such as the G-PACT project, that can develop perceived sport competence and perceived health benefits may promote short-term and lifelong PA engagement (Jose et al., 2011).

4.4.1. Limitations

Although a modest sample size was used for this formative exploration study, the primary aim was to inform the development of the G-PACT project. The sample comprised participants with the same geographic and demographic characteristics as the G-PACT project target population and allowed for an in-depth insight into their perceptions of school-based PA. Additionally, similar qualitative work with adolescent girls regarding PA has been completed with smaller sample sizes (Mitchell, Gray, et al., 2015). The recruitment of girls to attend the focus group sessions was particularly difficult and illustrated some of the challenges researchers face when working with this population. Teachers reported to the research team that a lack of interest from the girls and involvement from their parents (consent) were the main contributing factors to low engagement in the focus groups. In the future, taster sessions and 'word of mouth' campaigns could be utilised to increase participant engagement in exploratory research (Jago et al., 2011).

4.4.2. Conclusion

This study provides an insight into adolescent girls' perceptions and experiences of school-based PA. The study shows the usefulness of exploring these perceptions and experiences by PA level and not as a homogenous group. The findings highlight the importance of choice, peer groupings, non-competitive opportunities and PA competence to girls' school-based PA behaviours. The results demonstrate how the school environment can support and restrict girls' engagement in school-based PA. These outcomes will directly inform the design, content and implementation of the G-PACT project. Allowing adolescent girls, separated by PA level, the opportunity to

provide meaningful accounts of school-based PA opportunities is important to the development and improvement of these provisions.

4.4.3. Implications for School Health

This exploratory study provides useful information for PA promotion with adolescent girls within the school setting. The findings illustrate the importance of consultation with adolescent girls. Schools should look to increase non-competitive PA opportunities within the school setting especially for those girls not highly active. These PA opportunities should provide adolescent girls with autonomy in the form of choice and control of activities, competence through providing a skill improvement option and should allow the girls to participate with their friends for to increase enjoyment. For example, giving girls the choice of multiple team games were winning is not the primary focus and allowing self-selected teams. Teachers should be provided with the support and encouragement to implement these provisions both during PE teaching and after-school PA opportunities.

Chapter 4 Conclusion

This article demonstrates the formative work contributing towards the development of the complex intervention presented in Chapter 5 (G-PACT project). In accordance with MRC guidelines, it is recommended to conduct formative work with the target population of complex interventions to inform intervention design and implementation. This chapter identifies constructs which need to be closely considered when designing PA interventions for this population such as, choice, peer

groupings, non-competitive opportunities and PA competence. These factors were used to inform the G-PACT intervention discussed in Chapter 5. Additionally, this study provides and insight into adolescent girls' perceptions of current school-based practices, and highlights practical considerations for teachers and practitioners to explore in future programming.

Thesis Study Map

Study	Objectives and Key Findings
Study 1 - The Effectiveness of School-Based Physical Activity Interventions for Adolescent Girls: A Systematic Review and Meta-analysis	Objectives <ul style="list-style-type: none"> - Assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. - Systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis.
	Key Findings <ul style="list-style-type: none"> - The meta-analysis indicated a small but significant positive effect of school-based interventions on adolescent girls' PA. - Sub-group analyses indicated small but significant effects for multicomponent interventions and interventions underpinned by theory.
Study 2 - Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls Peer Activity (G-PACT) Intervention Study	Objectives <ul style="list-style-type: none"> - Qualitatively explore adolescent girls' understanding of PA - Explore adolescent girls' experiences of and perceptions towards engagement in school-based PA. - Explore adolescent girls' beliefs about factors important to facilitate PA engagement.
	Key Findings <ul style="list-style-type: none"> - Girls with lower levels of activity desire more non-competitive PA opportunities within the school setting and perceive the after-school club environment as being for sporty girls only - Regardless of activity level, girls gained greater enjoyment from PA when participating with friends and having greater autonomy over activity within the school setting.

Study 3 - The Feasibility of a Novel School Peer-led Mentoring Model to Improve the Physical Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project	Objectives <ul style="list-style-type: none"> - Assess the feasibility of recruiting and retaining adolescent girls to a school peer-led mentoring intervention. - Examine the feasibility of collecting accelerometer data to examine the PA levels and ST of adolescent girls. - Assess if a peer-led mentoring model can impact adolescent girls' PA levels and ST.
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Study 4 - The Feasibility and Acceptability of The Girls Peer Activity (G-PACT) Peer-led Mentoring Intervention

Chapter 5

Study 3: The Feasibility of a Novel School Peer-led Mentoring Model to Improve the Physical Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project



GIRLS PEER ACTIVITY

The main outcomes of this study have been published in *Children*:

Owen, M. B., Kerner, C., Taylor, S. L., Noonan, R. J., Newson, L., Kosteli, M.-C., . . . Fairclough, S. J. (2018). The Feasibility of a Novel School Peer-Led Mentoring Model to Improve the Physical Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project. *Children*, 5(6).

<https://doi.org/10.3390/children5060067>

The published article can be found in Appendix 10.

5.1. Introduction

One strategy that is relatively underused and consequently understudied in school PA interventions is the use of peer-led approaches (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Harrington et al., 2018; Sebire, Edwards, Campbell, et al., 2016). Peer-led, peer leadership, and peer-assisted learning are terms that are frequently used interchangeably. The commonality is that each strategy is underpinned by a learning process whereby friends learn from and with others (Jenkinson et al., 2012). Peer-led involves similar aged peers (Jenkinson et al., 2012), interacting with and motivating their classmates to initiate, continue and sustain positive behaviour (Barr-Anderson et al., 2012; Campbell et al., 2008). Importantly, not all peers are friends, thus leadership selection is important to ensure peer-led interventions target a range of friendship groups. Previous interventions using the peer-led model to increase PA have shown the potential to increase girls' MVPA (Barr-Anderson et al., 2012; Corder, Brown, et al., 2016). Peer-led learning in combination with cross-age mentoring could be of benefit to adolescent girls. This innovative approach could provide another

option to girls who may not be attracted to the sometimes competitive, rigorous, and potentially uncomfortable nature of traditional school-based PA (Jenkinson et al., 2012).

The purpose of this investigation was to evaluate the feasibility of a novel school peer-led mentoring model designed to improve PA levels and reduce ST of adolescent girls (ages 13-15 years). This study aimed to (1) assess the feasibility of recruiting and retaining adolescent girls to a school peer-led mentoring intervention, (2) examine the feasibility of collecting accelerometer data to examine the PA levels and ST of adolescent girls, and (3) assess if a peer-led mentoring model can impact adolescent girls' PA levels and ST.

5.2. Methods

5.2.1. Design

The G-PACT Project was a three-arm, parallel group, non-randomised feasibility trial. Schools were allocated to each trial arm based on their ability and resources to implement the proposed intervention. The reporting of this study followed the CONSORT extension guidelines for feasibility and pilot trials (Eldridge et al., 2016). Trial registration number: ISRCTN51511240.

5.2.2. Participants

Two-hundred and forty-nine Year 9 adolescent girls (13-15 years old) from three mixed-sex secondary schools situated in West Lancashire, north-west England were

invited to participate in the G-PACT project. The three secondary schools were located in areas with similar socio-economic characteristics, based on the UK Indices of Multiple Deprivation (IMD) deciles (UK decile 6 or 7; (McLennan et al., 2015)). The IMD is a UK Government measure comprising seven areas of deprivation including income, employment, health, education, housing, environment and crime. Year 9 girls (13-15 years old) were invited to participate in the project and all data were collected at their respective schools.

5.2.3. Intervention Development

Firstly, emails were sent to Head of Physical Education (PE) departments at local schools inviting them to attend an initial meeting. Prior to this study, one of the schools had previously participated in phase one of this project, an initial exploration study, which assessed girls' PA levels and explored girls' experiences and perceptions of school-based PA. The purpose of the meeting was to obtain input from the teachers regarding potential interventions designed by the lead researcher. This engagement with key stakeholders is crucial to the success and implementation of school-based interventions (van Sluijs & Kriemler, 2016).

Initially, the intervention plan was to implement a peer-led walking intervention, which incorporated wearable technology in order for girls to track their own activity levels and set themselves activity goals. However, after discussions with the teachers they highlighted concerns regarding the practicality and engagement of such intervention with adolescent girls. Specifically, teachers reported lack of space on the school grounds for girls to walk during school hours. The teachers were supportive of the peer-led approach and commented how it would build upon previous leadership

activities in the schools and provided a more sustainable model to target adolescent girls PA behaviours. The teachers were also keen to develop their after-school PA opportunities as this was highlighted by all schools as any area with low attendance with adolescent girls.

Following the meeting with the schools, the lead researcher used the feedback provided by the teachers to adapt the peer-led approach to incorporate more a more practical intervention including after-school PA opportunities for adolescent girls. With input from the research team, feedback from the PE teachers, and phase one data, a new 7-week peer-led school PA intervention was developed.

Individual follow-up meetings with each of the participating schools were held to obtain input from the teachers regarding the new G-PACT intervention design, implementation and evaluation. The teachers were complimentary of the new design and keen to move forward with the project. The teachers were keen for the undergraduate students to be involved in the intervention delivery and commented how this role modelling aspect was particularly novel would good for the girls development.

5.2.4. Recruitment

A purposeful sampling strategy was used to recruit schools (Patton, 2005). Schools were recruited following initial project meetings detailed above. Three schools that attended the original meetings, including the school used in phase one, were recruited to participate in the current intervention. The PE teachers in each respective school

used convenience sampling during PE classes to recruit Year 9 girls to participate in the intervention.

After discussions with PE teachers, regarding suitability for the peer leadership role, 15 to 16 girls were recruited from PE cohorts to become Leaders in each school. The selection of the Leaders was initiated by the PE teachers based on a set of desirable role criteria (leadership abilities, communication skills, potential role model, confidence and social influence) as assessed by the teachers' experiences with the girls. It was made clear to the teachers that the Leaders did not have to be 'sporty' or physically active, as the intervention aimed to engage girls across all activity levels. This method was selected as it was presumed that the teachers would be best suited to identify girls meeting the criteria in their individual environments.

All girls were informed about data collection measures involved in the project and the additional intervention component (after-school PA opportunity) relating to their school.

5.2.4.1. Consent

Recruitment of participants in school-based research can be difficult and lead to greater time commitments for teachers (Spence, White, Adamson, & Matthews, 2015). Research has shown that active consent (i.e. opt in) leads to biased samples and bias estimates of the measured outcomes (Shaw, Cross, Thomas, & Zubrick, 2015). This could lead to mis-targeted behavioural policies and interventions. Active consent approaches require significant input from teachers to collate parental replies and often lead to low response rates (Shaw et al., 2015). Therefore for low-risk research, rigorous passive consent (i.e. opt out) procedures which can result in higher

participation rates, lower costs, and reduced burden on teachers are recommended (Spence et al., 2015).

Previous studies, (Pokorny, Jason, Schoeny, Townsend, & Curie, 2001; Spence et al., 2015) including school PA studies, (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Lawlor et al., 2011; Thompson-Haile, Bredin, & Leatherdale, 2013) have utilised a passive consent (i.e., opt out) approach rather than an active consent approach, with the former (Pokorny et al., 2001) being found to significantly increase participation (82% return for passive consent compared to 33% for letters direct to parents). Passive consent has been found to lead to less time-consuming recruitment periods, higher participation rates and more representative samples, without compromising data quality (Spence et al., 2015). Whereas, active consent has been found to underestimate the prevalence of childhood obesity, particularly in girls (Strugnell et al., 2018). This has led to a call for more school-based intervention studies with children investigating health outcomes to move to opt-out consent processes for better scientific outcomes (Strugnell et al., 2018).

The passive consent method has previously been successful on a large scale PA school based peer-led approach (Go Active) in the UK (Corder, Brown, et al., 2016). Corder and colleagues achieved a recruitment rate of 78% using passive consent for their protocol which included objectively measured PA using accelerometers, questionnaires assessing psychological constructs, and anthropometric measurements (Corder, Brown, et al., 2016). During phase one of the G-PACT project (Chapter 4) there was a low rate (26%) of returned informed active consent. The passive approach has the potential to make significant difference to the efficiency of

participant recruitment, and the external validity of a study with a hard to reach population (adolescent girls).

Moreover, the passive consent method to obtain parental/carer permission has been found to be an ethical and appropriate way of informing parents/carer of 'low-risk' prevention research (Lawlor et al., 2011). It avoids the problems of low response rates and significant sampling bias encountered in research which has used active consent procedures with parents/carer of young people involved in school-based research (Lawlor et al., 2011). In addition, passive consent is consistent with the consent process used for the National Child Measurement Programme which involves children having their height and weight measured, and which is administered in UK primary schools (NHS, 2018).

One potential limitation of the passive consent approach is that researchers need to ensure that parents/carers receive the option to withdraw their child from the study, in accordance with ethical guidelines. Moreover, Thompson-Haile et al. (2013) adopted the passive consent approach in their large scale COMPASS study investigating children's health behaviours. Parents were contacted through multiple communication platforms through school systems (i.e., direct text messages, direct emails, school newsletters, and letters home). A similar approach was adopted with the school-based Go Active intervention with adolescents (Corder, Brown, et al., 2016). Therefore, the G-PACT project adopted a similar approach to ensure full adherence to ethical guidelines (Appendix 3.).

School communication networks (i.e. letters home, direct text messages and emails) were used to inform parents/carers about the study and the option to opt-out. Parents

were provided with consent information at least two weeks before the start of data collection to ensure that they had ample time to respond should they not want their child to participate. Parents/carers were also sent reminders 7 days before the deadline to give a further opportunity to opt their child out. These processes ensured that all parents/carers are well informed about the study and had adequate opportunities to respond Thompson-Haile et al. (2013).

This passive consent recruitment protocol demonstrates the rigor of the passive consent approach when used alongside appropriate procedures with children and young people (Spence et al., 2015). The passive consent approach had the full support of all participating schools, and was the teachers preferred method of consent. Ethical approval was granted from the Faculty of Arts and Sciences Research Ethics Committee at Edge Hill University (SPA-REC-2016-340).

5.2.5. Description of Intervention

The intervention incorporated a peer-led mentoring model based on Social Cognitive Theory (SCT) (Bandura, 1986, 1997, 1998) and Self-determination Theory (SDT) (Ryan & Deci, 2000). This peer-led approach has been used previously in PA interventions with older children acting as Mentors (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016). The current study however, employed a novel approach by utilising a three-tier peer-led mentoring design. The intervention was developed with input from key stakeholders (PE Teachers and adolescent girls) and G-PACT phase one data. The intervention incorporated a 7-week peer-led mentoring programme with an educational component that was consistent across all schools. As seen in Figure 5.1. below, the intervention had a three-tier design as follows: Mentors (undergraduate

students), Leaders (Y9 girls selected by teachers), and Peers (whole Year 9 cohort). It was intended that these older Mentors would be role models as well as Mentors to the Leaders. This mentoring approach has been found to be appealing to adolescents and has shown promise in influencing PA levels (Corder, Brown, et al., 2016; Corder et al., 2015). The Mentors transfer their PA knowledge and leadership guidance to Leaders who disseminate this knowledge to their Peers.



Figure 5.1. The intended direction of knowledge transfer from Mentors to Leaders to Peers.

During the first session, the leaders were informed of their roles in the project and discussed with mentors the best way to fulfil their roles and responsibilities within their respective schools. Through informal discussions, the Leaders were encouraged to disseminate the information they had learnt through their educational sessions to their friends and Peers. The Leaders were also asked to help to design information leaflets and posters to encourage more PA, including advertising the new after-school PA opportunities where appropriate. This peer-led approach was used as social influence through friends and peers and is crucial for adolescents to attain the best health behaviours in the transition into adulthood (Viner et al., 2012).

5.2.5.1. Mentors (Intervention Delivery Providers)

The Mentors were six final year undergraduate students (n=6) studying Physical Education and School Sport Bachelor degrees at Edge Hill University. As part of their degree programme, Mentors had successfully completed a PA and health module, which included teaching on school-based interventions. The Mentors were purposely female, as it was anticipated this would help them build a greater rapport with the adolescent girls and potentially be considered role models (Bandura, 1986, 1997, 1998). Each school had three Mentors supporting their Leaders, with some Mentors working in multiple schools. To ensure intervention fidelity and build rapport, the same three Mentors were present at their designated schools for all sessions.

5.2.5.2. Educational Leadership Sessions

Who provided intervention?

The Mentors delivered a series of educational leadership sessions for the Leaders which incorporated information on PA, health, motivation, barriers to PA, ideas to increase PA, ideas how to encourage Peers to be more physically active, and social support for their role (Table 5.1.).

The educational sessions were theoretical (SDT and SCT) in their design and applied multiple behaviour change techniques during delivery (e.g., goal setting, reviewing behaviour goals, social support and problem solving (Michie et al., 2013)) (Appendix 4.). The sessions were designed to increase levels of self-determination through the provision of opportunities to support girls' three basic psychological needs of autonomy, competency and relatedness (Deci & Ryan, 2002). The sessions also aimed to develop the Leaders' self-efficacy to be physically active themselves and to support

their Peers to engage in more PA (Bandura, 1997, 1998). These sessions were all designed by the lead author who used SDT and SCT to structure the sessions content and delivery approaches.

Table 5.1. The 7-week leadership and educational training programme for all three schools.

Week	Location	Activity
1	University	Introduction & Leadership & PA
2	School	PA & Motivation
3	School	PA & Goal setting
4	School	PA & How to increase activity
5	School	PA & How to support others
6	School	Support session
7	School	Support session

The educational sessions were solely delivered by the Mentors who received extensive training and ongoing supervision from the lead author. This training included information on different delivery methods, content knowledge and theoretical underpinning. The training sessions were facilitated by three mentors who delivered the content to 14-16 Leaders. Tasks within the sessions were often broken into small group work to encourage discussion. These educational sessions were designed to last no more than one hour in duration.

Where and when was the intervention delivered?

The first session was conducted at the university campus, with the following six sessions delivered on a weekly basis at the Leaders school. The sessions were conducted within the school day or straight after school depending on the timetable and facilities available by each individual school. The session at the university and the session in the school were delivered in large classrooms or sports hall, which provided room for 'active tasks' to be completed. These were educational tasks, which incorporated PA opportunities. For example, one activity required girls to do shuttle runs in the sports hall whereby PA and health information was transferred from one end of the sports hall to the other and complied on a poster. With the team with the most information in a 10 minute period being the winners.

Intervention Implementation Consistency

The Mentors received a weekly checklist of content and tasks for each session, which they would complete after their session with the Leaders. This checklist was used to ensure continuity and consistency across the three intervention schools. As part of the checklist, Mentors were given the opportunity to discuss how the sessions were received by their Leaders. The Mentors met with the lead researcher on a weekly basis to feedback on the sessions and to discuss the checklist. Mentors were provided with the opportunity to suggest additions or new delivery methods to best engage their leaders to keep them engaged. During these feedback sessions, the content for the following week was also discussed along with how best to deliver the sessions. This method allowed the lead researcher to maintain consistency in delivery and content coverage of the intervention across the three schools.

5.2.5.3. Physical Activity Components

In addition to the mentoring, educational sessions, peer-support and information sharing that were consistent across all schools; there were three different PA session variations of the intervention (Figure 5.2.). In conjunction with the education sessions, school one (*Class*) received weekly structured, class-based Les Mills *Body Attack* (<https://www.lesmills.com/uk/workouts/group-fitness/bodyattack/>) PA sessions delivered by trained and certificated instructors (relevant qualified undergraduate students). School two (*Choice*) received the option to choose what type of PA session they wanted to be part of their intervention. These sessions were designed with input from both Leaders and their Peers (Multi-sports, dance, circuit training etc.). For school one and two, these PA sessions (approx. one hour in duration) ran weekly after-school from week 2 through to week 7. These after-school PA sessions had a maximum capacity of 30 girls due to space and resources restrictions. Finally, school three (*No Club*) did not receive an after-school PA component until after cessation of the intervention. The Leaders in the *No Club* school were asked to help develop this new after-school programme as part of their leadership role.

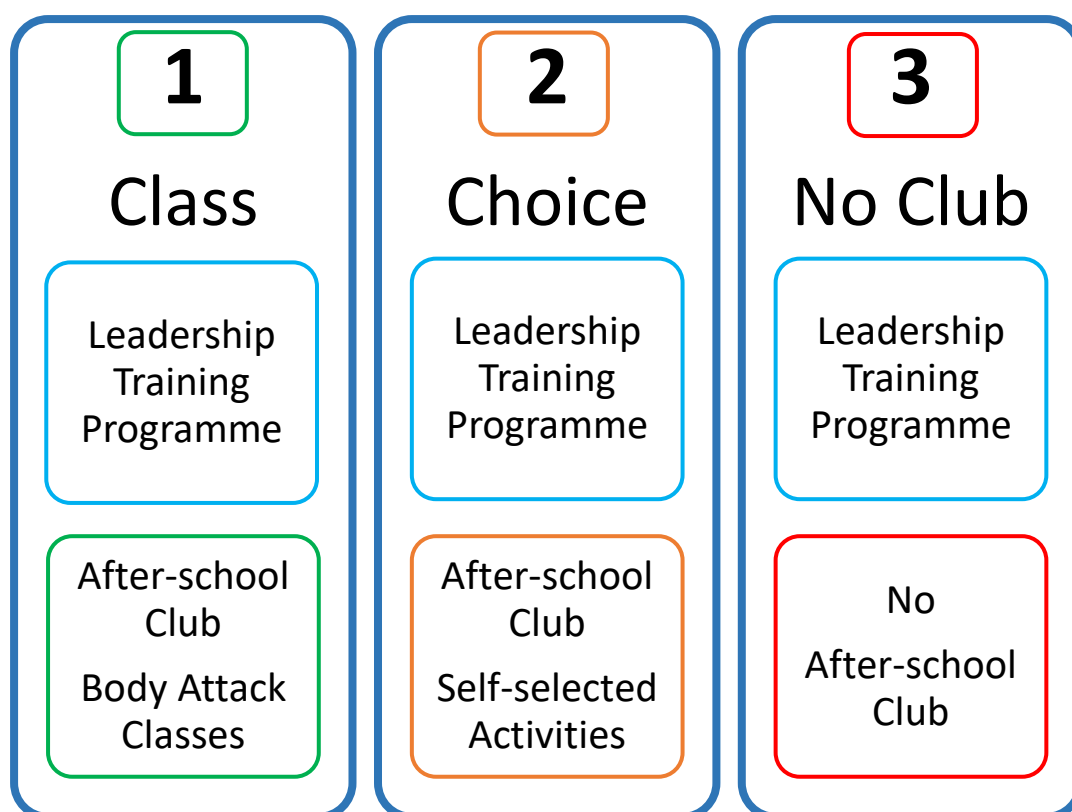


Figure 5.2. The educational information transfer and additional PA option for three different variations of the intervention (3 separate schools).

5.2.5.4. Intervention Timeline

The intervention was delivered for 7-weeks. During week 1, after the Leaders were selected, they were invited by school to separately visit the university campus for a half-day workshop, delivered by their Mentors, introducing them to the project and their role within it. This session detailed the overall aim of the intervention, which was to increase PA levels of Year 9 adolescent girls in their respective schools, and how it was the Leaders' role to encourage their friends to be more physically active over the next 7-weeks and beyond. This session was the same across all three schools. The remaining 6-weeks of the intervention were delivered on a weekly basis at the Leaders' school. These sessions occurred at lunchtime or after-school depending on

the facilities available in each school. Thus, Leaders from all three schools attended weekly leadership sessions (week 1-7) delivered by their Mentors and the Leaders and Peers from school one and two had the option to attend the additional after-school PA sessions (week 2-7) which occurred on a different day of the week to the leadership sessions.

5.2.6. Measures

The impact of the intervention on adolescent girls' PA levels and ST was assessed through 7-day wrist-worn accelerometry at baseline (week 0) and post-intervention (week 8). Supplementary self-reported measures of PA enjoyment, self-efficacy, wellbeing, and peer social support were taken at baseline and post intervention. These measures were used to assess change in psychological states due to the intervention.

5.2.6.1. Anthropometrics

Girls' stature, weight and waist circumference were measured using standardised procedures (Lohman, Roache, & Martorell, 1992). Stature was assessed to the nearest 0.1cm using a portable stadiometer (Leicester Height Measure, Seca, Birmingham, UK). Body mass was assessed to the nearest 0.1 kg (761 scales, Seca). Body Mass Index (BMI) and weight status was calculated from stature and weight measurements as a proxy measure of adiposity (Cole, Bellizzi, Flegal, & Dietz, 2000). BMI z-scores were calculated and UK age and sex specific BMI cut points applied to categorise girls as underweight, normal weight or overweight/obese (Cole et al., 2000)(NICE, 2014). Predicted Age at Peak Height Velocity (APHV) was used as a proxy measure of biological maturation using gender-specific equations (Moore, McKay, et al., 2015).

Waist circumference was measured using an anthropometric tape to the nearest 0.1cm. A measure of central adiposity was calculated using the waist circumference-to-height ratio (WHtR) (Mehta, 2015), with 0.5 set as the global boundary for cardiometabolic risk (Browning, Hsieh, & Ashwell, 2010). All anthropometric measurements were conducted in a private area (not overlooked) in schools, by trained female research assistants under the supervision of the lead researcher. Some research assistants also had a role in the intervention as Mentors.

5.2.6.2. Socio-Economic Status

Neighbourhood-level socio-economic status was calculated from reported home postcodes using the 2015 IMD calculator (McLennan et al., 2015). The IMD is a UK government-produced measure composed of seven areas of deprivation (income, employment, health, education, housing, environment, and crime). IMD rank scores were matched to their corresponding IMD deciles, where decile 1 represents the most deprived 10% of areas nationally and decile 10 the least deprived 10% of areas.

5.2.6.3. Recruitment (Aim 1)

Counts and proportions of the number of girls in the schools providing passive parental consent were used to address Aim 1. This approach has been used previously in feasibility studies (Jago et al., 2012).

5.2.6.4. Physical Activity Outcomes (Aims 2 and 3)

In order to assess the feasibility of collecting accelerometer data (Aim 2) and to assess the impact of a peer-led mentoring model on girls' PA levels (Aim 3) all participants

were asked to wear a wrist worn tri-axial accelerometer (ActiGraph GT9X, theActiGraph.com, FL, USA) to provide objective estimates of PA. These wrist worn devices have been found to be a valid measure of PA (Ekblom, Nyberg, Bak, Ekelund, & Marcus, 2012; Fairclough, Noonan, et al., 2016; Scott et al., 2017). With children and young people, wrist worn devices reduce missing data and improve wear time compliance (Fairclough, Noonan, et al., 2016; Scott et al., 2017), which increases accuracy of PA estimates. Girls were instructed wear the devices on their non-dominant wrist for seven consecutive days. The accelerometers were positioned on top of the non-dominant wrist, proximal to the ulnar styloid process, so that the vertical axis of the ActiGraph was parallel to the longitudinal axis of the lower arm (Crouter, Flynn, & Bassett Jr, 2015). The instruments were worn over a period of seven days, to provide a reliable estimate of usual PA behaviour on weekend days and weekdays (Trost, Pate, Freedson, Sallis, & Taylor, 2000). An information sheet regarding device use was given at both measurement points. Girls were instructed to wear the devices all the time (24 h·day⁻¹) except when engaging in water-based activities such as swimming or bathing.

Data collection took place during the school term from January to March 2017 therefore; data were representative of usual winter/spring free-living activities. Accelerometers were synchronised with Greenwich Mean Time (GMT) and initialised to record raw accelerations at a frequency of 100 Hz. After seven days of wear, the accelerometers were downloaded in ActiLife (v.6.11.8, ActiGraph) and saved in raw format (GT3X files). These raw files were then converted into CSV format to facilitate raw data processing in R (<https://cran.r-project.org>) using the GGIR package (v.1.5-17)

(Van Hees et al., 2013). The GGIR package converted raw tri-axial accelerometer signals (van Hees et al., 2014) into one omnidirectional measure of acceleration termed 'Signal Vector Magnitude' (SVM). SVM was calculated from raw accelerations from the three axes minus 1 *g* which represents the value of gravity (i.e., $SVM = \sqrt{x^2 + y^2 + z^2} - 1$), after which negative values were rounded to zero. This metric has previously been referred to as the Euclidean Norm Minus One (ENMO) (van Hees et al., 2014; Van Hees et al., 2013). ENMO values were further reduced by calculating the average per 1s epoch (expressed in *mg*) over the seven monitored days (Fairclough, Noonan, et al., 2016; Noonan et al., 2017).

Accelerometer wear time periods for raw data were estimated on the basis of the standard deviation and value range of each axis, calculated for 60 min moving windows with 15-min increments (Van Hees et al., 2013). This approach has been applied previously in ActiGraph studies involving youths (Fairclough, Noonan, et al., 2016; Noonan et al., 2017; Rowlands et al., 2016; Taylor et al., 2017). A time window was classified as non-wear time if, for at least two out of the three axes, the standard deviation was less than 13.0*mg* or if the value range was less than 50*mg* (Sabia et al., 2014). Accelerometer wear time inclusion criteria were at least 10 hours of wear for a minimum of three weekdays. These wear time inclusion criteria have previously been used with school PA interventions exploring the whole day and school day PA levels (Hollis, Sutherland, et al., 2016; Jago et al., 2012; Mooses et al., 2017; Nettlefold et al., 2011), and is sufficient to produce reliable estimates of PA (Rich et al., 2013). Published ENMO prediction equations were used to identify cut-points for classifying MVPA (3 METs (child-adjusted) = 201*mg*) (Hildebrand, VAN, Hansen, & Ekelund, 2014),

as used with adolescent girls previously (Rowlands et al., 2018). However, there is no consensus as to the most appropriate ENMO ST cut-points for adolescents (Hildebrand et al., 2017). Thus, we applied the Hildebrand et al. (2014) regression equations using 1.5 METs (child-adjusted), which resulted in a value of 50 *mg* for the ST cut-point.

5.2.6.5. Psychological Outcomes

A paper-based survey was administered to assess four psychological outcomes. The survey consisted of four components: 7-item PA enjoyment scale (Kendzierski & DeCarlo, 1991; Motl et al., 2001), 7-item wellbeing scale (Tennant et al., 2007), 10-item social support scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987), and 8-item self-efficacy scale (Motl et al., 2000; Ward, Saunders, & Pate, 2007). The questionnaires have been validated and used previously with adolescents (Clarke et al., 2011; Hsu et al., 2011; Liang, Lau, Huang, Maddison, & Baranowski, 2014; Ward et al., 2007). The surveys were completed at the start of the girls PE lesson under the guidance of a class teacher and at least two research assistants.

5.2.7. Data Analysis

Individual and school level descriptive statistics (mean and SD) were calculated for all measured variables including, the proportion of adolescent girls meeting the recommended daily 60 minutes of MVPA guidelines (Chief Medical Officers, 2011). Recruitment figures and accelerometer data provision were calculated by school level. The primary outcome variables were ST and MVPA. Psychological outcomes were secondary outcomes. Cronbach's alpha was used to test the questionnaires internal reliability. Raw data were checked for normality through visual (histograms, box-plots,

Q-Q-plots) and parametric (K-S-test) assessments. Once normal distributions were confirmed, repeated measures ANCOVA were conducted to compare the three schools from baseline to post-intervention (post-INT) for primary and secondary outcomes. Three time windows: whole day (7am-11pm), school day (9am-3.15) and after-school (3.15-4.45) were analysed to examine differences across the three schools for ST and MVPA. In each ANCOVA, adjustments were made for baseline BMI, PA enjoyment, wear time and ST or MVPA, respectively. If significant *time x school* interactions were observed, school-specific pairwise comparisons were made to investigate the differences over time. Sub-group analyses were conducted to investigate the differences for Leaders only and Peers only using the same ANCOVA procedures detailed above. Effect sizes were calculated using Cohens *d* for larger samples ($k > 20$) (all girls & Peers only), and Hedge's *g* for smaller sample sizes ($k < 20$) (Leaders) which provides a correction based on sample size. All analyses were conducted using IBM SPSS Statistics v.23 (IBM, Armonk, NY) and statistical significance was set at 0.05.

5.3. Results

5.3.1. Recruitment and Data Provision

The participant recruitment and baseline data provision rates are shown by school in Table 5.2. The passive consent approach achieved a 94% recruitment rate with only 15 (6%) girls opting out of the whole project. Valid baseline accelerometer data were collected from 206 (88%) of the 234 consenting participants. The provision of valid

accelerometer data was greater at baseline than post-INT (66%). This resulted in a reasonable baseline to post-INT attrition rate with 76% completing all measures.

Table 5.2. Participant recruitment, opt-out rate, data provision, and mean weekly attendance to 6-week after-school club programme in the G-PACT project.

School	Number of Girls in Year Group	Opted Out (n, (%))	Provided Accelerometer Data (n, (%))		Weekly ASC Attendance (Mean, (%))
			Baseline*	Post-INT*	
1.Class	102	9 (8.8)	82 (88.2)	70 (75.3)	14 (47)
2.Choice	76	3 (3.9)	64 (87.7)	42 (57.5)	12 (40)
3.No Club	71	3 (4.2)	60 (88.2)	45 (66.2)	N/A
Total	249	15 (6.0)	206 (88.0)	157 (66.3)	N/A

Notes. ASC = After-school club, *Numbers represent provision of valid data (3 valid weekdays with minimum 10 hours wear)

5.3.2. Descriptive Information

Descriptive and anthropometric characteristics of the participants are displayed in Table 5.3. There were no significant between group differences. The weight status calculation indicated that at baseline, 28% of the girls were overweight or obese, 67% of the girls were of a healthy weight and 5% were underweight. Only 2% of all girls across the three schools met the recommend daily MVPA guidelines at baseline.

Table 5.3. Descriptive and anthropometric characteristics of participants by individual school and overall (Mean (SD) or percentage).

	1. Class (n = 93)	2.Choice (n = 73)	3.No Club (n = 68)	All Girls (n = 234)
Age (y)	14.0 (0.3)	14.0 (0.3)	14.1 (0.3)	14.0 (0.3)
Stature (cm)	160.7 (5.8)	160.4 (5.7)	161.7 (9.5)	160.9 (6.9)
Body Mass (kg)	56.8 (10.2)	55.4 (8.8)	57.8 (12.1)	56.7 (10.5)
BMI (kg·m2)	22.4 (5.9)	21.7 (3.2)	22.4 (6.6)	22.2 (5.6)
BMI z-Score	0.7 (1.0)	0.7 (0.9)	0.6 (1.4)	0.7 (1.1)
WHtR	0.46 (0.04)	0.44 (0.04)	0.46 (0.07)	0.45 (0.05)
Maturity Offset (y)	1.8 (0.4)	1.8 (0.4)	1.9 (0.6)	1.8 (0.5)
Weight Status (%)				
<i>Underweight</i>	2.2	5.5	9.2	5.2
<i>Normal Weight</i>	70.0	67.3	61.6	66.7
<i>Overweight/Obese</i>	27.8	27.3	29.2	28.1
IMD Score	6.6 (2.6)	5.7 (3.0)	6.8 (2.0)	6.4 (2.6)
MVPA (min·day-1)	23.3 (11.9)	26.4 (13.3)	32.2 (12.9)	26.9 (13.1)
MVPA Guidelines (%)	0	3.1	3.3	1.9

Notes. BMI = Body mass index, WHtR = Waist-to-height-ratio, Maturity Offset = predicated time from Peak Height Velocity, IMD = Indices of Multiple Deprivation, MVPA levels = mean MVPA level in minutes at baseline, MVPA Guidelines = % of girls meeting the recommended daily 60 minutes of MVPA at baseline.

5.3.3. Whole day (7am-11pm) PA data

There was a main effect for *time* ($p < .001$) and a *time x school* effect ($p = .026$) for girls' whole day ST (Table 5.4.). Paired t-tests revealed a significant increase in girls' whole day ST (17.2 minutes, $p = .006$, $d = 0.43$) for *No Club* school.

Table 5.4. Whole day adjusted means (SE) for ST and MVPA at baseline, post-INT and mean difference.

School	Time	ST (Minutes)		Adjusted difference in means (95% CI)	MVPA (Minutes)		Adjusted difference in means (95% CI)
		Mean	SE		Mean	SE	
1.Class	Baseline	728.0	0.0	-1.6	28.7	0.0	3.2*
	Post-INT	726.4	4.5	(-10.0 to 7.5)	31.9	1.15	(0.8 to 5.7)
2.Choice	Baseline	728.0	0.0	12.9	28.7	0.0	1.0
	Post-INT	740.9	6.5	(2.0 to 20.3)	29.7	1.6	(-1.9 to 2.7)
3.No Club	Baseline	728.0	0.0	17.2*	28.7	0.0	-3.5*
	Post-INT	745.8	5.7	(4.8 to 26.5)	25.2	1.4	(-5.8 to -0.5)

Notes. * $p < 0.05$, Mean Difference = change baseline to post-INT

There was no main effect for *time* ($p > .05$) but, there was a *time x school* effect ($p = .004$) for MVPA (Table 5.4.). The girls in the *Class* school significantly increased their whole day MVPA by just over 3 minutes (3.2 minutes, $p = .009$, $d = 0.33$). Whereas, the girls in the *No Club* school significantly decreased their MVPA levels by just over 3 minutes from baseline to post-INT (-3.5 minutes, $p = .016$, $d = 0.36$).

5.3.4. School day (9am-3.15pm) PA data

There was a main effect for *time* ($p = .004$) and a *time x school* effect ($p < .001$) for school day ST. The girls in the *No Club* school significantly increased their school day ST by 14.0 minutes ($p < .001$, $d = 0.90$) (Table 5.5.). There was no main effect for *time* ($p > .05$) but there was a *time x school* effect ($p < .001$) for MVPA. The girls in *Class* school significantly increased their school day MVPA levels by 1.2 minutes ($p = .004$, d

= 0.37). Whereas, the girls in *No Club* school significantly decreased their MVPA levels by 2.7 minutes from baseline to post-INT ($p < .001$, $d = 0.79$).

Table 5.5. School day adjusted means (SE) for ST and MVPA at baseline, post-INT and mean difference.

School	Time	ST (Minutes)		Adjusted difference in means (95% CI)	MVPA (Minutes)		Adjusted difference in means (95% CI)
		Mean	SE		Mean	SE	
1.Class	Baseline	281.3	0.0	-4.9	10.6	0.0	1.2*
	Post-INT	276.4	2.0	(-8.2 to -0.6)	11.8	0.6	(0.5 to 2.5)
2.Choice	Baseline	281.3	0.0	-3.4	10.6	0.0	1.9
	Post-INT	277.9	2.9	(-9.8 to 0.3)	12.5	0.8	(0.2 to 3.0)
3.No Club	Baseline	281.3	0.0	14.0**	10.6	0.0	-2.7**
	Post-INT	295.3	2.6	(9.5 to 18.8)	7.9	0.7	(-4.6 to -2.1)

Notes. * $p < .05$, ** $p < .001$, Mean Difference = change baseline to post-INT

5.3.5. After-school club period (3.15pm-4.45pm)

There was a significant main effect for *time* in after-school club period ST ($p = .006$) but not for MVPA ($p > .05$). However, between 3.15pm and 4.45pm there was no *time* \times *school* effect ($p > .05$) for ST or MVPA (Table 5.6.).

Table 5.6. After-school club period adjusted means (SE) for ST and MVPA at baseline, post-INT and mean difference.

School	Time	ST (Minutes)		Adjusted difference in means (95% CI)	MVPA (Minutes)		Adjusted difference in means (95% CI)
		Mean	SE		Mean	SE	
1.Class	Baseline	62.9	0.0	-1.4 (-4.5 to -0.7)	5.1	0.0	0.0 (-0.1 to 1.2)
	Post-INT	61.5	1.1		5.1	0.4	
2.Choice	Baseline	62.9	0.0	2.7 (-0.3 to 5.8)	5.1	0.0	0.0 (-1.2 to 1.2)
	Post-INT	65.6	1.6		5.1	0.6	
3.No Club	Baseline	62.9	0.0	1.1 (-2.3 to 4.2)	5.1	0.0	-1.2 (-2.6 to -0.1)
	Post-INT	64.0	1.4		3.9	0.5	

Notes. Mean Difference = change baseline to post-INT

5.3.6. Sub Group Analyses

5.3.6.1. Leaders

There was no main effect for *time* ($p > .05$) but, there was a *time x school* effect ($p = .012$) for Leaders' whole day MVPA levels. Between 7am and 11pm, the Leaders from *No Club* school significantly reduced their MVPA levels (-9.3 minutes, $p = .002$, $g = 1.07$). There was no change for *Class* or *Choice* Leaders. There was no main effect for *time* or between group effects (both $p > .05$) for Leaders school day ST or MVPA levels. During the after-school period, there was no main effect for *time* for Leaders' ST and MVPA (both $p > .05$) but, there was a *time x school* effect for Leaders' MVPA ($p = .012$) and ST ($p = .021$). The *No Club* school Leaders significantly increased their ST (8.4 minutes, $p = .002$, $g = 1.05$) and decreased their MVPA levels (-3.2 minutes, $p < .001$, $g = 1.50$).

5.3.6.2. Peers

Between 7am and 11pm, there was a main effect for *time* for Peers' ST ($p < .001$) but not for MVPA ($p > .05$). There was no *time x school* effect for Peers' ST or MVPA (both $p > .05$). Between 9am and 3:15pm, there was a main effect for *time* for Peers' ST ($p < .001$) but not for MVPA ($p > .05$). However, there was a *time x school* effect for Peers' school day ST and MVPA (both $p < .001$). During the school day, Peers from *No Club* school significantly increased their ST (15.5 minutes, $p < .001$, $g = 0.76$) and decreased their MVPA levels (-2.9 minutes, $p < .001$, $g = 0.64$). During the after-school period there was a main effect for *time* for Peers' ST ($p < .001$) but not for MVPA ($p > .05$) and there was a *time x school* effect for Peers' ST ($p = .042$). Peers from *Class* school significantly decreased their after-school ST (-2.3 minutes, $p = .005$, $g = 0.33$).

5.3.7. Psychological outcomes

All four questionnaires had good internal consistency with Cronbach's Alpha values > 0.80 (social support (0.89), PA enjoyment (0.92), wellbeing (0.83) and self-efficacy (0.85)). There were positive main effects for *time* for social support, wellbeing, self-efficacy and PA enjoyment (all $p < .001$). After controlling for differences at baseline, there were no *time x school* effects ($p > .05$) for social support, wellbeing or self-efficacy for all participants. However, there was a *time x school* effect for PA enjoyment ($p = .034$). Paired t-test revealed a significant increase in PA enjoyment for girls in *Class* school ($p = .009$, $d = 0.28$) but not for girls in *Choice* or *No Club* schools.

5.4. Discussion

The purpose of this investigation was to evaluate the feasibility of a peer-led school PA intervention for adolescent girls. The results show that it was feasible to recruit and retain adolescent girls to the project (intervention attrition 24%). There was a significant intervention effect on girls' whole day and school day MVPA levels for *Class* school, and a negative impact on whole day and school day MVPA and ST for *No Club* school. The *Choice* school showed no significant differences across the two main outcome variables, but trends were in a positive direction for girls' whole day and school day MVPA levels.

The passive consent (opt-out) approach appears crucial to the feasibility of this recruitment process. The passive consent approach utilised returned a recruitment rate of 94% from the eligible girls in Year 9. This is higher than previous studies using similar methods with this population (78% and 77%) (Corder, Brown, et al., 2016) and significantly higher than opt-in consent (23%) (Corder, Atkin, Ekelund, & van Sluijs, 2013). Critically, this approach did not require any active engagement from the parents/carers unless desired. Passive consent is also used in England's National Child Measurement Programme, which involves primary school children (aged 4-5 and 10-11 years old) having their height and weight measured (NHS, 2018). In the current study, adolescent girls and their parents/carers were provided with multiple opportunities to opt-out, including for each individual measure (height, weight, accelerometer etc.). Thus, for low-risk non-intrusive research (Lawlor et al., 2011), such as the current study, this approach allowed for greater recruitment of adolescent

girls, who can be a difficult population to reach. For these reasons, this approach should be considered by others doing similar work in the future.

The uptake in the after-school club opportunities was relatively low, however, this is common during this time period with adolescent girls (Sebire, Edwards, Kesten, et al., 2016). The after-school Bristol Girls Dance Project (BGDP) had a mean attendance of 13 girls per session (max=32) (Jago et al., 2012; Sebire, Edwards, Kesten, et al., 2016) which was similar to the attendance observed in the current study (14 and 12 girls per session (max = 30) in each *Class* and *Choice* schools respectively). Illustrating the difficulties recruiting and retaining adolescent girls specifically in after-school PA clubs. Low uptake in the after-school clubs could have been due to time conflicts after school for adolescent girls or the advertisement strategies used in school.

It was feasible to collect accelerometer data with adolescent girls. A 24% data attrition rate from baseline to post-INT is comparable to previous PA assessments with adolescent girls. There was a 11% and 20% (week 9 and week 20) attrition rate in the BGDP (Jago et al., 2012) and in the larger Go-Active intervention pilot trial, 45% attrition (week 8) (Corder, Brown, et al., 2016). Girls were easily retained through the school-based structure and passive nature of the intervention design. Other than the after-school club opportunities, the Peers had little direct active engagement in the intervention. The intervention was largely disseminated through the Leaders who were constantly supported by their Mentors. Despite high recruitment and retention, the number of girls providing valid accelerometer data was low. This was predominantly due to difficulties with device wear time compliance and provision of valid baseline and post-INT data. Three weekdays of 10 hours wear time is a stringent

inclusion criteria but is commonly used to provide an accurate reflection of habitual weekday PA (Hollis, Sutherland, et al., 2016; Mooses et al., 2017). To increase compliance to device wear, multiple reminders during the measurement period or incentives could have been provided (Corder, Brown, et al., 2016), but lack of resources and funding prohibited this strategy.

The *Class* school which received the class-based Les Mills *Body Attack* (<https://www.lesmills.com/uk/workouts/group-fitness/bodyattack/>) in addition to the leadership training programme saw the greatest improvements in the outcome variables, including PA enjoyment. Multicomponent interventions compared to single component have been found to be more effective impacting girls' PA levels (Owen et al., 2017). This infers that this class-based approach combined with the peer-led approach may have contributed towards the positive impact. The *Body Attack* sessions combined movements including running, lunging and jumping with body weight strength exercises such as push-ups and squats. These classes are primarily designed for older adolescents or adults. This more mature form of fitness-based class which was non-competitive and non-team based could have appealed more to the current adolescent girls (Mitchell, Gray, et al., 2015; Mitchell, Inchley, Fleming, & Currie, 2015) and been more conducive to MVPA participation compared to other traditional approaches (e.g. netball or hockey) (Fairclough, McGrane, et al., 2016b). However, it must be noted that the Les Mills classes require certified instructors, which can be an additional cost. If this intervention was to be scaled-up, a more cost-effective fitness class alternative may have to be explored.

There were significant unfavourable changes in ST and MVPA for the *No Club* school that received the same leadership and educational training programme as the other schools but received no additional after-school PA opportunity. This finding is consistent with previous systematic reviews of school-based PA interventions for adolescent girls, with single component interventions found to be less effective impacting girls' PA levels (Owen et al., 2017). Across multiple time windows, MVPA decreased and ST increased significantly.

Having no additional after-school club to complement the leadership training and peer-led approach could have contributed towards the findings compared to the other schools in the intervention. However, the increases in ST were large (17 minutes whole day and 14 minutes school day) thus; the lack of an after-school component was unlikely to be the only contributing factor to the increase in ST. Similarly, the BGDP found no evidence that an after-school dance programme could increase girls (11-12 years old) PA (Jago, Edwards, Sebire, Tomkinson, Bird, Banfield, May, Kesten, Cooper, & Powell, 2015; Jago et al., 2012) illustrating the difficulties of changing PA behaviours in adolescences. Nevertheless, not having a PA prompt (after-school PA opportunity) could have been a factor limiting the Leaders' ability to motivate and support Peers. However, from the current results, it was difficult to infer the cause(s) of the findings. The peer-led approach by design makes it difficult to assess the implementation of the intervention (Carroll et al., 2007; Naylor et al., 2015). There was no exact measure of volume, intensity, quality of delivery and participant responsiveness to the messages the Leaders passed on to their Peers, and how much coverage these intervention messages achieved across all Peers (Carroll et al., 2007). Qualitative accounts from the

Leaders and Peers may illuminate some important contextual information to supplement and explain the quantitative findings.

The *Choice* school showed no significant changes from baseline to post-INT. This finding is similar to the Girls Active programme, which contained a peer-led element, and showed no change in MVPA at 14 month follow-up (Harrington et al., 2018). However, the changes observed in the *Choice* school were in a positive direction which is consistent with the Go-Active peer-led intervention which also found a positive trend in MVPA levels (Corder, Brown, et al., 2016). With the well-established declines in adolescent girls' PA levels (Cooper, Goodman, Page, Sherar, Esliger, van Sluijs, Andersen, Anderssen, Cardon, Davey, et al., 2015; Dumith, Gigante, Domingues, & Kohl III, 2011), this finding was encouraging, as the intervention prevented the anticipated decline in PA.

Providing choice and autonomy has been well established as a successful approach influencing youths' PA enjoyment and engagement (Brooks & Magnusson, 2007; Dishman et al., 2005; Mitchell, Gray, et al., 2015; Ryan & Deci, 2000). Enjoyment is a stable and consistent psychological construct, which predicts PA participation and adherence, thus it is deemed to be crucial to health behaviour change in youth (Best, Ball, Zarnowiecki, Stanley, & Dollman, 2017; Gebremariam et al., 2012; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). Therefore, with the provision of choice it is possible that a longer-term intervention may have seen significant positive PA changes with this population. Compared to the more expensive Les Mills classes, this choice after-school element would be relatively cheap to implement on a larger scale if the intervention was to be up-scaled.

The peer-led mentoring model with leadership training sessions were implemented across all schools, but the current findings infer varying impacts of the main intervention component. Due to the complex nature of the intervention design, intervention fidelity and implementation were difficult to assess. Nevertheless, checklists were used to provide structure and consistency across sessions. However, the Mentors' interactions with Leaders, and Leaders' subsequent interactions with Peers cannot be quantified and could have influenced intervention fidelity and implementation (Naylor et al., 2015).

Peer-led approaches are novel in PA interventions with adolescents (Ginis et al., 2013). The current study aimed to assess the feasibility of this approach, in accordance with the Medical Research Council guidance for developing and evaluating complex interventions, it is expected that refinements and modifications are needed before further piloting the intervention (Craig et al., 2008; Moore, Audrey, et al., 2015). The refinements or additions to the current project could include a greater emphasis on reducing ST during the school day and the provision of more MVPA opportunities on multiple school days both during and after-school. Comprehensive school-based approaches have been suggested as effective strategies to increase young peoples' PA (Carson et al., 2014; Centers for Disease Control and Prevention, 2015; McMullen et al., 2015). The G-PACT intervention was largely delivered through the PE departments of each individual school. In contrast, the Go-Active intervention adopted a wider school approach, incorporating intervention features into morning registration classes which showed initial success (Corder, Brown, et al., 2016). However, the Go-Active

intervention was a mixed-sex intervention for adolescents, meaning this approach was easier to implement in a mixed-sex school.

5.4.1. Strengths and Limitations

A major strength of this study was the novel peer-led mentoring model incorporating older Mentors. This peer-led mentoring model allowed for a three-tier knowledge transfer process and provided Leaders with support to aid their Peers' PA behaviours. This mentoring approach could have relevance to other health related disciplines such as positive lifestyle choices including diet and nutrition. However, it is unclear if this collaborative approach between schools and a university would be sustainable over a longer period due to university students' time commitments and career progression. That said, once the Leaders have received extensive training and mentoring, less frequent meetings with the Mentors could be incorporated into the intervention design.

Another strength was the detailed recruitment and accelerometer data provision processes in a moderately sized feasibility trial, which can inform the design of future interventions. Additionally, the study achieved a high recruitment rate using the passive consent method with adolescent girls in the school setting. However, due to the recent General Data Protection Regulation (GDPR) changes in the GDPR is Europe-wide, active opt-in processes will be needed in future research with children and young people (<16 years old). This has implications for future school based research as active opt-in leads may reduce recruitment rates and result in less representative samples compared to passive opt-out consent (Spence et al., 2015). Furthermore, the use of objectively measured PA and raw data processing to assess the intervention

effectiveness helped avoid the uncertainty of pre-processed data such as counts and the possibility that signal filtering methods alter study results (Freedson, Bowles, Troiano, & Haskell, 2012a; Peach, Van Hoomissen, & Callender, 2014a). This school-based, girls only intervention was underpinned by two behaviour change theories (SDT and SCT), as recommended to promote intervention effectiveness (Owen et al., 2017; Pearson et al., 2015).

It is however, important to recognize that the data reported here originate from a non-randomised design so there was greater potential for bias within the study. Further, there was no control group used, therefore it is difficult to distinguish the true effect of the intervention. However, the MRC complex interventions guidance advises that if impractical, randomisation and the use of a control group is not essential in feasibility designs (Craig et al., 2008). A longer follow up period than 7 weeks could have been used to assess the intervention effects, but school-term time constraints and data collection resources did not allow for this. Another limitation of the study was that there was also no specific measure of motivation for PA, which could have been useful to assess the change in motivation and potential future intentions to engage in PA. Due to the design of the intervention, it was difficult to distinguish which girls benefitted from the peer-led aspect of the intervention and how much impact this had on their PA behaviours. Tracking social networks could be considered in future peer-led interventions to assess the links between friends and how this may develop as a result of the intervention (Hunter et al., 2015).

All three schools were mixed-sex, which could have negatively influenced the intervention implementation. Girls may have not felt comfortable discussing PA

around their male counterparts. Only a small percentage of the girls attended the weekly after-school PA club, thus it was difficult to distinguish how beneficial this component was to changes in PA habits. The lead researcher was mainly responsible for ensuring consistency in delivery and content of the leadership training programme across the three schools. This could be seen as a potential source of bias, however, standardised checklists were used with the Mentors to provide structure to the sessions and reduce potential bias. These session checklists included coverage of the weekly content and delivery methods to ensure consistency across the three schools. Future studies should include process evaluation to allow implementation fidelity to be assessed (Moore, Audrey, et al., 2015).

5.4.2. Conclusions

This feasibility study of the G-PACT intervention showed feasibility of recruitment and data collection procedures for adolescent girls. The peer-led mentoring model shows promise for impacting girls' PA levels when combined with an after-school club PA opportunity. The fitness class-based intervention resulted in the most favourable changes in MVPA and ST. Moreover, the school that did not receive the after-school club alongside the peer-led mentoring model showed reductions in MVPA and increases in ST across the intervention duration, which suggests that this was an important component of the project. The peer-led mentoring model requires further investigation, including qualitative work, which could contextualise the quantitative results reported above. The peer-led mentoring model provides a novel method to target the PA behaviours of adolescent girls and their peers.

Chapter 5 Conclusion

The research article presented in this chapter was informed by findings from chapter 3 and 4. The G-PACT intervention contained multiple components and was underpinned by behaviour change theory. The intervention was designed to build upon peer relationships to encourage and support positive PA behaviours. The concept for the after-school club was developed directly from the findings from chapter 4, with girls having a choice over activities they wanted to participate in after school. The findings from the current chapter illustrate the feasibility of this approach to (1) increased PA of adolescent girls, (2) recruit girls to the study, and (3) collect accelerometer data with this population. A (fitness) class based PA component appeared to lead to the greatest increases in PA for adolescent girls. Moreover, including a PA component in addition to the main peer-led component seems crucial to the effectiveness of this approach to increase PA. Qualitative accounts, gathered from key intervention stakeholders (Chapter 6) could help to elaborate on the feasibility and acceptability of the intervention in the school setting.

Thesis Study Map

Study	Objectives and Key Findings
Study 1 - The Effectiveness of School-Based Physical Activity Interventions for Adolescent Girls: A Systematic Review and Meta-analysis	<p>Objectives</p> <ul style="list-style-type: none"> - Assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. - Systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis. <hr/> <p>Key Findings</p> <ul style="list-style-type: none"> - The meta-analysis indicated a small but significant positive effect of school-based interventions on adolescent girls' PA. - Sub-group analyses indicated small but significant effects for multicomponent interventions and interventions underpinned by theory.
Study 2 - Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls Peer Activity (G-PACT) Intervention Study	<p>Objectives</p> <ul style="list-style-type: none"> - Qualitatively explore adolescent girls' understanding of PA - Explore adolescent girls' experiences of and perceptions towards engagement in school-based PA. - Explore adolescent girls' beliefs about factors important to facilitate PA engagement. <hr/> <p>Key Findings</p> <ul style="list-style-type: none"> - Girls with lower levels of activity desire more non-competitive PA opportunities within the school setting and perceive the after-school club environment as being for sporty girls only - Regardless of activity level, girls gained greater enjoyment from PA when participating with friends and having greater autonomy over activity within the school setting.
Study 3 - The Feasibility of a Novel School Peer-led Mentoring Model to Improve the Physical	<p>Objectives</p> <ul style="list-style-type: none"> - Assess the feasibility of recruiting and retaining adolescent girls to a school peer-led mentoring intervention.

Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project	<ul style="list-style-type: none"> - Examine the feasibility of collecting accelerometer data to examine the PA levels and ST of adolescent girls. - Assess if a peer-led mentoring model can impact adolescent girls' PA levels and ST.
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Key Findings

- It was feasible to recruit and retain adolescent girls to the school peer-led mentoring intervention.
 - The peer-led mentoring model in combination with a fitness class based PA after-school club increased girls' whole day and school day MVPA levels.
 - The peer-led mentoring model alone did not appear to positively impact girls PA levels.
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Study 4 - The Feasibility and Acceptability of The Girls Peer Activity (G-PACT) Peer-led Mentoring Intervention	Objectives
	<ul style="list-style-type: none"> - Assess if a school peer-led mentoring intervention with an educational component was feasible and acceptable for adolescent PA Leaders. - Examine if a peer-led mentoring intervention was feasible in communicating PA messages with adolescent girls (13-14-years old). - Assess if a peer-led intervention with educational components in combination with PA opportunities was feasible and acceptable in the secondary school setting.

Chapter 6

Study 4: The Feasibility and Acceptability of the Girls Peer Activity (G-PACT) Peer-led Mentoring Intervention



GIRLS PEER ACTIVITY

A manuscript reporting main outcomes of this study has been submitted to Children and is currently under peer review:

Owen, M. B., Kerner, C., Newson, L., Noonan, R., Curry, W. B., Kosteli, M. C., & Fairclough, S. J. (*In Review*). The Feasibility and Acceptability of The Girls Peer Activity (G-PACT) Peer-led Mentoring Intervention. *Children*

6.1. Introduction

Feasibility studies are increasingly undertaken to explore unanticipated factors in the development and implementation of complex interventions and are recommended to inform piloting and upscaling (Craig et al., 2013; O’Cathain et al., 2015). The implementation process in complex interventions can be affected by multiple unexpected factors (Durlak & DuPre, 2008), and present various problems for evaluators (Craig et al., 2008). Appropriate and well conducted qualitative research can however, make an important contribution to assess the feasibility and acceptability of complex interventions (O’Cathain et al., 2015).

The purpose of this investigation was to evaluate the feasibility and acceptability of the Girls Peer Activity (G-PACT) peer-led mentoring intervention. The study aimed to assess if a school peer-led mentoring intervention with an educational component was (1) feasible and acceptable for adolescent PA Leaders, (2) feasible in communicating PA messages with adolescent girls (13-14-years old), and (3) feasible and acceptable in the secondary school setting when used in combination with additional PA opportunities.

6.2. Methods

The G-PACT project was a feasibility and acceptability study of a novel three-tier peer-led mentoring intervention. The reporting of this study followed the CONSORT extension guidelines for feasibility and pilot trials (Eldridge et al., 2016). Trial registration number: ISRCTN51511240.

6.2.1. Participants

Two-hundred and forty-nine Year 9 adolescent girls (13-14 years old) from three mixed-sex secondary schools located in West Lancashire, North-West England were invited to participate in the G-PACT project. The three secondary schools were located in areas with similar socio-economic characteristics, based on the UK Indices of Multiple Deprivation (IMD) deciles (UK decile 6 or 7; (McLennan et al., 2015)).

6.2.2. Recruitment

The G-PACT recruitment process has been described in detail previously in Chapter 5 (5.2.2. *Recruitment*).

6.2.3. Intervention

The G-PACT intervention has been described in detail previously in Chapter 5 (5.2.4. *Intervention*).

6.2.4. Measures

All consenting girls (Leaders and Peers) who completed post-intervention (post-INT) data collection (week 8), as part of the G-PACT project, participated in focus groups to

assess the feasibility and acceptability of the intervention. Eight focus groups were conducted with Leaders (n=40), twenty-eight focus groups with Peers (n=185), two focus groups with Mentors (n=6), and three interviews with teachers (n=4). Across all three schools, each data collection session at week 8 lasted approximately 1 hour in duration. It was anticipated that all data collection measures and analysis would take 6 months to complete.

6.2.4.1. Quantitative

6.2.4.1.1 *Questionnaire (Peers)*

Preceding the focus groups, Peers were asked to complete a short questionnaire about their experiences in the G-PACT project. The questionnaire contained four closed-questions ('yes/no' responses) relating to; interaction with PA Leaders, additional PA with friends, PA information received from Leaders and new PA information learnt. The questionnaire also included one open-ended question asking the Peers to provide some feedback about their experiences in the G-PACT project over the past 7-weeks. This questionnaire method was used to provide Peers with an additional opportunity to discuss their experiences of the G-PACT project (Flick, 2014). The questionnaire method was used to support the focus group responses and provided data triangulation (Carter et al., 2014; Levitt et al., 2018).

6.2.4.2. Qualitative

6.2.4.2.1. *Semi-structured Focus Groups (Peers, Leaders, and Mentors)*

The focus groups were conducted to elicit girls' experiences of the 7-week intervention. The focus group method was utilised with adolescent girls rather than

face-to-face individual interviews as girls were expected to feel more confident and comfortable in a group in their own environment (Flick, 2014; Hennessy & Heary, 2005; Horner, 2000; Krueger, 2014). Focus group methodology enabled open discussion and allowed the girls to build on each others' comments (Hennessy & Heary, 2005; Horner, 2000). The focus groups were semi-structured so that the researcher could ask probing question around the pre-defined topics, keep the discussions relevant to the study aims, and to ensure consistency across focus groups (Krueger, 2014). All three focus group types (Peers, Leaders, and Mentors) were conducted using the same research protocol and followed a pre-defined schedule containing questions appropriate to their role in the G-PACT project (Appendix 5. for Peers, Appendix 5. for Leaders, and Appendix 7. for Mentors).

The girls were grouped by role in the G-PACT project; therefore, Leaders and Peers participated in separate focus groups. The focus groups for Leaders and Peers were conducted at the school sites. Trained research assistants conducted the Leaders and Peers focus groups. Focus groups were conducted with all available Peers and Leaders (rather than a sub-sample), to assess the feasibility, impact, and exposure of the intervention, as they were the primary target of the intervention. Each focus group with Peers and Leaders contained 5-8 girls, and lasted between 10 and 22 minutes, with an average duration of 15 minutes. The focus group durations were constricted due to the time limitations within the schools (i.e., curriculum time).

Mentor focus groups were conducted 2-weeks post intervention. Mentor focus groups were conducted at the university site by the lead author and research assistant. The two Mentor focus groups were more in-depth, contained three Mentors each, and

lasted 1 hour and 14 minutes and 1 hour and 20 minutes, respectively. All participants were reminded that during the focus groups they could withdraw at any time without reason (Krueger, 2014).

6.2.4.2.2. Interviews (Teachers)

Interviews were also conducted with teachers to elicit their perceptions of the feasibility of the intervention and its subsequent impact on adolescent girls. The teachers were asked about their thoughts and observations of the G-PACT project including, the Leaders and Peers interactions. Teacher interviews were conducted 2-weeks post intervention. Teacher interviews were conducted at their respective school sites by the lead researcher. The interviews with teachers from *Class* and *No Club* school were conducted on a 1:1 basis. For the convenience of the teachers in the *Choice* school, the interview was conducted on a 1:2 ratio as they held a shared role and both wished to participate. The interviews followed a semi-structured interview schedule, similar to the focus groups (Appendix 8.). This allowed for discussion on the key topics but also allowed flexibility to explore important areas as they arose. The interviews lasted 25-35 minutes, averaging 31 minutes.

6.2.5. Analyses

6.2.5.1. Quantitative

6.2.5.1.1. Questionnaire (Peers)

Frequency counts and percentages were calculated by school for the four 'yes/no' questions. The text from the open-ended question was added to the main analysis described below.

6.2.5.2. Qualitative

6.2.5.2.1 Focus Groups and Interviews (Peers, Leaders, Mentors and Teachers)

Audio-recordings from the focus groups and interviews were transcribed verbatim. To ensure confidentiality, all names were removed and replaced with pseudonyms.

The separate data sources (focus groups, interviews, open-ended questionnaires) were pooled together by intervention group (*Class, Choice or No Club*) and a mixed analysis approach was taken for complimentary purposes (Figure 6.1.). This allowed for comparisons within and across data sources for each intervention group (Carter et al., 2014; Levitt et al., 2018). The data was analysed individually by intervention group (school). Additionally, the data from the Mentors was analysed separately to the individual intervention group data, as the Mentors were involved across all intervention groups (Figure 6.1.). Following this, the themes from each analysis were compared and integrated to provide an overall analysis of the feasibility and acceptability of the G-PACT project. The pooled data resulted in 877 pages of raw transcription data (Times New Roman, size 12, double spaced).

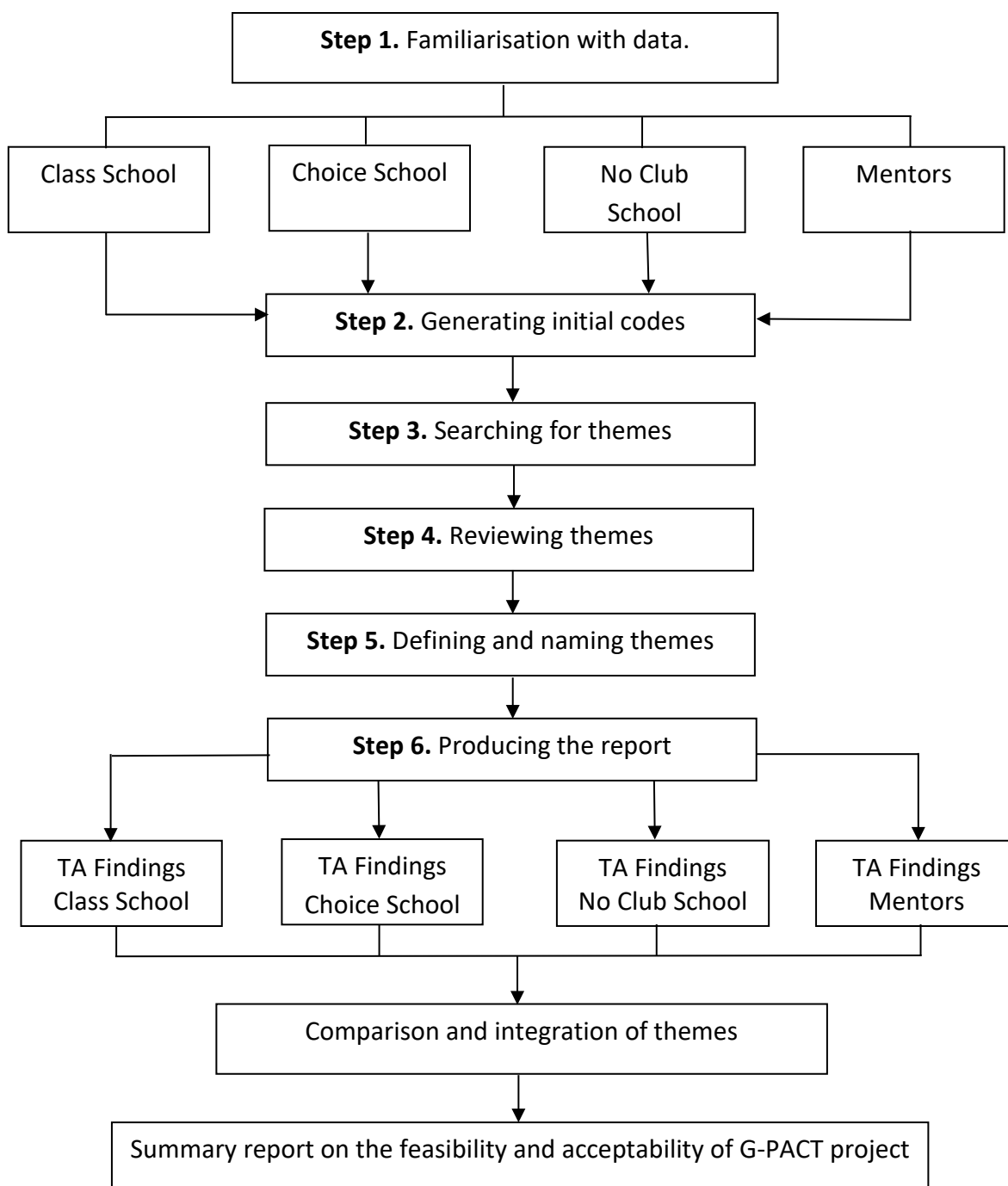


Figure 6.1. The application of step-by-step thematic analysis (TA) (Braun & Clarke, 2006).

An inductive and data driven analytical strategy was used to identify and discuss the salient themes repeated across and within the transcripts (Thomas, 2006). Thematic

analysis has been utilised for this study as it allows for the identification of patterns and meaning across a dataset and provides a flexible approach needed in feasibility studies (Braun & Clarke, 2006). An inductive analysis, rather than a deductive or mixed analysis, allowed for a ground-up approach and the exploration of unanticipated findings, which are common in feasibility studies (Thomas, 2006). Inductive thematic analysis of the data was completed, by the first author, using the step-by-step guide set out by Braun and Clarke (2006) (Figure 6.1.). Data saturation was achieved when the ability to obtain additional new information was attained, and when further coding was no longer feasible (Fusch & Ness, 2015).

All codes and emergent themes were checked by a second (MCK) to ensure consistency of coding. Any disagreements were discussed (MO and MCK) until a 90% agreement level was reached. After finalising themes, quotes that were deemed to best represent each theme were then selected to illustrate the wider views of the specific population. Triangulation of data was achieved through comparison of the questionnaire, focus group and interview data (Carter et al., 2014; Levitt et al., 2018). To ensure methodological rigour, credibility, and trustworthiness (Levitt et al., 2018; Nowell et al., 2017), the focus groups, interviews and open-ended questionnaire responses were independently reviewed by third author (RN), and were then cross-examined against the data in reverse, from the themes to the data sheets (Noonan, Boddy, Fairclough, & Knowles, 2016). Any disagreements were discussed between the three authors (MO, RN, and MCK; 90% agreement).

6.3. Results

6.3.1. Questionnaire

Table 6.1. Peer questionnaire data for G-PACT project experiences and engagement.

Question	1.CLASS n=78	2.CHOICE n=64	3.NO CLUB n=49
Spoke to the PA Leaders	25%	46%	30%
Did additional PA with friends or classmates over the past 7-weeks	78%	68%	70%
Received information about PA over the past 7-weeks from friends or classmates	34%	62%	32%
Learnt something new about PA over the past 7-weeks	36%	50%	62%

Notes. % = Percentage of respondents who answered 'yes' to question.

The responses were not consistent across schools for some elements (Table 6.1.). For example, in the *Choice* school 62% of Peers received information about PA from friends or classmates over the previous 7-weeks compared to just 34% and 32% in the *Class* and *No Club* school respectively. The *Choice* school reported the highest percentage of Peers who had spoken to a PA leader. Whereas, the *Class* school had the highest amount of Peers who reported doing additional PA with friends or classmates over the previous 7-weeks.

6.3.2. Thematic Analysis

6.3.2.1. Class School Themes

The main overarching themes arising from the data for *Class* school were: Engagement; Mentor Rapport; Leadership Selection; and After-school Club Advertising.

Engagement

Within *Class* schools, Peers generally reported doing more PA through involvement in the G-PACT project. Some attended the new after-school club, others engaged in more PA with their friends in other settings; *"We've been trying to do more runs but that's just because we wanted to"* (PFG1.8., P2., L85). Peers stated they received the PA information from their friends, but did not refer to their friends specifically as G-PACT 'Leaders'. The teacher reported that the key G-PACT project messages were promoted and as a whole the project was implemented as close to the protocol as possible, however the teacher acknowledged that some peers were not involved and perhaps messages were not ; *"filtered down enough"* (TI1., P5., L156). Peers stated they received the PA information from their friends but did not refer to their friends as 'Leaders'.

There appeared to be a gap in communication between the Leaders and some Peers. A number of Peers reported not knowing who the Leaders were, and thus had a limited understanding of the G-PACT project. Some Peers did not become engaged in the project because of perceived poor or lack of communication from their Leaders: *"We can't get involved if there not allowing us to get involved"* (PFG1.6., P5., L184). These communication issues were particularly apparent if the Peers and Leaders were not part of the same friendship groups.

Peers preferred receiving PA information from their friends. They reported that their friends had a greater influence on their behaviours more so than their teachers: *"I feel like they know what they're talking about because they are more our age"* (PFG1.9., P5., L199). Although, some Peers remarked that teachers could have advertised the

after-school club in addition to the Leaders as they didn't totally trust their friends information compared to the word of a teacher. The teacher acknowledged that she could have taken a more active role in the G-PACT project but wanted to leave it to the Leaders as that was the purpose of the project. There was no clear 'project identity' within the school. Some of the unengaged Peers believed that the G-PACT project centred on receiving accelerometers (watches) to measure PA. This theme inferred a lack of feasibility of the Leader to Peer relationship in the *Class* school.

Mentor Rapport

The teacher and Leaders reported that the Mentors' educational sessions were well received but the rapport between certain Mentors and Leaders could have been improved. For some of the Leaders the lack of rapport had a de-motivating effect on project engagement.

"So the Leaders, I don't know how much they made that connection with some of the Mentors ... on that initial day at University, it should have almost been a chance for those people to get to know each other a little bit to form that relationship" (T11., P6., L197-202).

The teacher stated that if the Mentors were able to establish a greater relationship with their Leaders, it may have helped the Leaders *"buy in a bit more"* (T11., P7., L224). Some Leaders wanted to take more of an active role in the G-PACT project and felt that the Mentors hampered this.

“we got told what to do so we weren’t leading anything... I’d prefer it if like we had like a group of pupils and like we lead them” (LFG1.7., P1., L12).

The Mentor to Leader approach was feasible but the Leaders wanted more independence, responsibility, and more PA embedded into the leadership and educational sessions. The teacher and Leaders suggested embedding the leadership and educational sessions within the usual school day (9am-3.15pm) as some Leaders did not like after-school aspect of the leadership sessions. The Leaders preferred the leadership and educational sessions to be held within school hours as some felt it was a ‘punishment’ to have to stay after-school.

Leadership Selection

The majority of the Leaders engaged in the intervention process, and all Leaders reported enjoying the first training session at the university and agreeing to take forward the leadership role. However, a small number of Leaders did not fulfil the roles they had agreed to and thus, did not implement the protocol as per agreed. As discussed above, this contributed towards some Peers being disengaged and unaware of the wider G-PACT project aims. The teacher acknowledged that she choose 3 or 4 girls that were not suitable to be Leaders, despite referring to the criteria set out by the research team.

“we selected students that were potentially Leaders, but not sports Leaders, and then I've got the wrong mix of students, which meant that the ones that potentially we would have engaged became disengaged because some of the girls were too domineering and intimidating” (I1., P1., L13-15).

The teacher states that this ‘wrong mix’ may have had a detrimental effect on the roles of other Leaders as they caused disruption in sessions and did not fully engage in the leadership role. If these Leaders had not been chosen this might have led to greater coverage for the intervention.

After-school Club Advertising

Details of the after-school club received good coverage through the handouts with the majority of the Peers aware of the new after-school programme. The after school club received an indifferent response the first week, but the girls reported their enjoyment as the weeks progressed.

“I went to the club and it was a bit boring at first but it got better. It definitely helped me to do more physical activity” (POQ. P2., L14).

However, the quality and exposure of the after-school club advertisement around the school could have been increased. Peers and Leaders stated that a lot of the advertising was around the PE department and this could have been increased to encompass TV screens around school, registration groups, and tannoy announcements. Non-attendance to the after-school club was due to numerous barriers including: lack of time; motivation; confidence; and travel home afterwards. Peers, Leaders and teachers suggested the concept of running promotional sessions,

during the school day, to introduce peers towards the new after-school club programme, as a potential method to increase participation: *“offering the girls some taster sessions in PE would have probably been a really big winner”* (T11., P1., L22).

“Their friends can tell them what it's like, but a lot of girls at that age don't have the confidence, so if they'd kind of almost been made to do it in a compulsory situation, they would have then thought, "Actually, I can do this. I am capable of this. I'm not as bad as I think. I will come after school". But that idea for some of those girls at that age, who maybe haven't been involved in sport, to then come down to a club that they're not really that sure about what it's about, it was too big a step for them. So I think we needed to have maybe made more tiny steps, rather than that be that. Even though their friend was going, it was still too much of a jump” (T11., P1., L25-32)

Peers and Leaders that attended the after-school club programme said it was good, but could have been more appealing and better advertised to their friends from the start. Leaders suggested that a ‘taster’ session could have been delivered in PE lessons to offer all girls an insight and experience of the after school club before it started.

6.3.2.1.1. Class School Summary

The main overarching themes arising from the data for *Class* school were Engagement, Mentor Rapport, Leadership Selection and After-school Club Advertising. Not all the girls were engaged in the G-PACT project, as some of the Leaders did not fulfil their roles as PA Leaders. This was mainly due to the leadership selection. Although the some of the chosen Leaders were confidence and influential, they were not suited to the PA leadership role. The Mentors struggled to build rapport with certain Leaders

and this also contributed towards the Leaders' engagement and subsequent interaction with their Peers. The Mentor to Leader relationship showed feasibility but this was reliant on the Leaders being engaged in their roles and the Mentors ability to build rapport. Leaders being chosen for the role. The after-school club was well received by the girls but a 'taster' session during PE lessons would have been useful to advertise the club and engage harder to reach girls at the start of the after-school club programme. The additional PA component was a feasible and acceptable method in combination with the peer-led mentoring model.

6.3.2.2. Choice School Themes

The overall themes originating from the data for the *Choice* school were: Leadership Role Clarity; Leader Engagement; Peer Engagement; and After-school Club Environment.

Leadership Role Clarity

In the *Choice* schools, Leaders showed a clear understanding of their roles and responsibilities as part of the G-PACT project. They understood the main purpose of the G-PACT project and illustrated good knowledge and understanding in relation to PA, health and leadership.

"We've been working with Mentors as a Leader to learn about how to encourage more of our friends to do physical activity. I've learnt lots of things about physical activity that I didn't know before and have been able to encourage my friends to get involved" (POQ2., P5., L212).

“to get other girls to be physically active, and that doesn’t mean going for a run every night, it could be just walking to and from school or even just walking to school” (LFG2.1., P3., L97-98).

The weekly leadership and educational sessions helped the Leaders develop their PA and health understanding. However, Leaders reported that clarity and confidence in their role took a few weeks to develop as they only had one session a week. It was evident that there was consistent knowledge transfer between Mentor and Leaders, which informed the Leaders role clarity. Some Leaders took the knowledge they had learnt and proactively applied it to their interactions with Peers; *“Move more, sit less is our slogan”* (LFG2.7., P1., L35), illustrating strategies used to motivate and encourage Peers to engage in more PA. The Leaders remarked the main skills they developed as part of the G-PACT project were their communication and motivational skills.

“how to communicate with other people, how to motivate them...and that you need to make sure you’re doing about 60-minutes of activity a day and that will help you increase your fitness too” (LFG2.8., P1., L25-26).

The Mentors were noted as main influence on their communication skills development, which were directly linked to the tasks from the leadership and educational sessions.

Leader Engagement

Leaders enjoyed the leadership and educational sessions which supported their continued engagement in their leadership roles. The Mentor to Leader relationship was feasible and acceptable, with Leaders commenting how the Mentors were a factor in their development and enjoyment. Leaders engaged with the mentoring process throughout. The session held at the university was noted as significant.

"I think the university status helps them as well, because they see it as like an aspiration or a hierarchy to us, because they're like, "Oh, this is school, and actually, these are coming in from university to do this with us, and that must be really special", and they love that" (T12., P1., L11-13).

Teachers revealed that the association with the university made the Leaders feel special and gave them something to aspire towards. Leaders reported that the Mentors created a positive and comfortable environment for the sessions *"very fun and upbeat"* (LFG2.1., P7., L297). This allowed Leaders the freedom to grow into their role and made them feel comfortable. This increased the Leaders' confidence and desire to attend the future sessions. The sessions held at lunchtime within the school allowed this relaxed atmosphere to grow and facilitated greater in-depth discussion between Mentors and Leaders. However, the Leaders found their role difficult at times and were not able to engage with all the Peers.

"A lot of people are just like nah can't be bothered... it was hard to motivate people to come. Like you have to try an like persuade some people to come, like bribe them (laughs)" (LFG2.7., P1., L42).

Specifically, Leaders reported difficulties communicating with hard to reach Peers, especially those that they were not close friends with. The Leaders in this *Choice* school intervention asked the teachers to support them, which resulted in the teachers organising an assembly for the Leaders to present to their peers in an effort to engage all and recruit to the after-school club. This was driven by the Leaders being pro-active in their roles, which in turn had a positive impact on the after-school club engagement.

Peer Engagement

Some Peers were able to provide a clear purpose of the G-PACT project after engagement with Leaders; *“It’s basically trying to encourage other students to do more physical activity to get healthy”* (PFG11., P12., L347). Furthermore, the majority of Peers were aware of the new after-school club programme; *“They were giving leaflets out about a new after-school club”* (PFG2.13., P1., L32). The vast majority of Peers commented that they received leaflets Leaders signposting them towards the new after-school club programme. However, some Peers reported not feeling engaged by the Leaders, and some did not know who their Leaders were. There was a perceived breakdown in the link between Leaders and the wider group of Peers. Despite the Leaders reporting attempts at engaging all peers, some Peers reported that they did not receive any information about PA from their Leaders and were not encouraged to engage in more PA.

Peers that attended the new after-school club programme reported enjoying it and liked the novelty (choice element) of the programme. The teachers were impressed with the uptake and engagement of the sessions compared to past after-school clubs.

The choice element was particularly useful engaging peers who had not previously participated in after-school PA sessions.

"It was the new activity. It was Clubbercise, that did it, and then the fact that they were asked what activities they wanted to do" (T12., P2., L68).

As the G-PACT project progressed, girls reported that the sessions improved and attendance increased. The teacher believed this was linked to positive word of mouth within friendship groups and they were pleased to see girls attend that they never thought would attend such after-school activity. For the Peers that did not engage in the after-school club programme, some reported wanting to attend but had unavoidable practical barriers preventing from doing so, such as family commitments or time conflicts.

After-school Club Environment

The new after-school programme created a positive environment that supported girls' PA behaviours. This Choice-based after-school club programme was both feasible and acceptable in this school. Peers, Leaders and teachers all provided positive accounts of the after-school programme.

"not every single kid in there will have had the same favourite activity, but when you start throwing all these like different names like Clubbercise and a bit of yoga or whatever, trampolining, they all go, "Oh yes, she likes that. Yes, I like that as well, and what about if we all do it?" (T12., P.,10., L319-322).

The girls enjoyed the activities especially trampolining and clubbercise. The teachers valued the novelty of allowing the girls to pick the activities they wanted *“because they had a choice of like new activities to do, that was more appealing to them”* (T12., P1., L9-10). The after-school programme allowed for choice and freedom, which gave Peers something they had not previously had, that provided greater enjoyment of the after-school club.

“everything we do is really different like clubbercise, ... we know the classic things in school like football, hockey, rugby, gymnastics but we don’t really do something that like different and more...like enjoyable, like have fun with your mates whilst you’re doing exercise” (LFG2.7., P10., L424).

“It’s not like...basic PE. It’s more like...made more fun and active for what you want to do instead of just a random sport” (PFG2.13., P6., L263-264).

Peers and Leaders acknowledged how the sessions were different to standard PE (e.g., they were more enjoyable) and this appealed to them. Some Leaders also assisted with delivery when they felt more confident. The teachers stated that the programme design, which centred on running a new activity each week, allowed the girls to start fresh each week, which kept them engaged.

“I liked it because it wasn’t so much exercise but it’s like fun exercise like you would look forward to it because you know you’re going to have a laugh but also doing exercise” (LFG2.6., P6., L273-274).

Compared to previous after-school clubs (such as Hockey), the teachers were pleasantly surprised by the positive response and uptake, teachers acknowledged how

Peers preferred the new after-school club programme. A reliable schedule was another contributing factor towards the success of the programme. Teachers stated that this was vitally important to constant attendance, as girls always knew it would be on the same time each week and the Mentors would always be there. Peers wanted the programme to last longer than 6 weeks. Additionally, Leaders were just starting to develop into their roles and wanted to take a more active role leading the after-school sessions.

6.3.2.2.1. Choice School Summary

The overall themes originating from the *Choice* school data were Leadership Role Clarity, Leader Engagement, Peer Engagement and After-school Club Environment. The Leaders clearly understood their roles and responsibilities. There was a strong link between Mentors and Leaders, demonstrating that this relationship was feasible and acceptable. The Leaders were committed to their roles and developed their Leadership skills as the G-PACT project progressed. There was a gap in communication between the Leader and some of Peers. The communication process between Leaders and Peers was acceptable to girls but needs refinement to improve effectiveness. Peers who engaged in the new after-school club programme enjoyed the novelty and choice provided within the sessions. The new after-school programme helped provide a positive motivational climate to support girls' PA behaviours. The additional PA opportunity was acceptable and feasible alongside the peer-led mentoring model as it provided Leaders with a school-based opportunity to encourage more PA within their friendship groups.

6.3.2.3. No Club School Themes

There were two main overarching themes emanating from the data from the *No Club School*: Leader Development; and Friendship Groups.

Leaders Development

The Leaders identified several personal improvements they had made as a result of the G-PACT project. The Leaders reported that the leadership and educational sessions with the Mentors had a significant impact on their leadership skills, communication skills and PA knowledge and understanding.

"I have learnt how to be more confident about leading a group of people in a sports activity. I have also learnt to help my friends get involved with activity. I have also learnt to encourage people more whilst doing activity and to get people to do more activity." (POQ3., P8., L177).

This is supported by the account provided by their teacher who said that the leadership aspect of the G-PACT project has been very well received. The teacher reported that the girls had grown into their role and subsequently grown in confidence over the intervention period. The Leaders specifically reported enjoying the first session at the university, especially learning about PA through active tasks. The Mentors and Leaders developed a feasible and acceptable relationship with good rapport and the Leaders felt comfortable talking to/with their Mentors.

“They were lovely ... it was dead different because they’re more laid back, they understand where we’re coming from ... it was a lot more informal ... because the Mentors were younger as well and they loved sport like we do, so they could relate to us a lot more” (LFG3.1., P3., L73-75).

Leaders noted their enthusiasm and relatableness were critical to the development of a strong relationship. The Mentors were seen as a type of role model who understood the Leaders more than the teachers because they were closer to their age and had shared interests. Moreover, the teacher believed that finding the right mix of Leaders in the group was critical to their development and experience within the G-PACT project.

“You need that element of some of them being into sports. I did pick a complete mix. I think they all slightly have got a passion for sport in whatever areas, some more than others. Some just enjoy it, some do lots of sports outside school, some just love the PE lesson, that's all they do” (T13., P1., L20-24).

The teacher mentioned how it was important the Leaders all had a passion for sport. The teacher goes on to discuss that although there was a ‘mix’ of Leaders, with different personalities, they all had good attitudes and were committed to their roles.

The Leaders demonstrated a high level of PA knowledge and understanding. Again, the Mentors were noted as a strong influence on Leaders knowledge and development. The Leaders were personally committed to their roles and perceived that they had learnt a lot of important information as part of the G-PACT project. Leaders were able to clearly state their main roles and responsibilities, which was

supported by their comprehensive understanding of the key PA educational messages. Overall, the Leaders had a positive experience within the leadership sessions, which supported their understanding and development into the PA Leader role. However, it is unclear how much their Peers benefitted from the Leader to Peer transfer of knowledge.

Friendship Groups

Leaders said they disseminated the PA information they had learnt to their friends, however, the information did not appear to disseminate across to all eligible Peers. Several Peers reported that they did not know who the Leaders were.

"I think people listened but then they didn't really do anything ... It made them think more but it probably didn't make them actually do anything ... because our closest friends you can tell them like what to do because they'll listen to you more and like ... like one of our friends me and her are both doing a challenge a day so we have to do exercise a day and its working and we're both doing it, so it's the information given makes us think more about it ... whereas friends that you're not actually close to don't really listen to you because people that you don't really know might like just think that it's a bit of a joke" (LFG3.8., P6., L.,241-247).

Peers who were not friends with the Leaders appeared to be unaware of the G-PACT project, and its wider aim to increase PA through friendship groups. These Peer accounts highlighted the importance of friendship groups to the feasibility of the Leader to Peer relationship. Although, the Leaders reported attempts to engage with all Peers, they also reported difficulties interacting with Peers who were not part of their friendship groups. This is linked to the concept of 'project identity'; mainly peers

did not acknowledge the overall aim of the G-PACT project but rather believed that the project focused on accelerometer measurement of PA. Leaders acknowledged not all Peers were fully engaged in the G-PACT project and reported they wanted more opportunities to access the wider group of Peers, which may have not been their close friends, through formal sessions.

“because we have been learning about it a lot and when we are going to explain to them normally some people need to be told twice just to remember... so I don’t think its affected them (Peers) enough ... I think it’s affected the Leaders more” (LFG3.8., P9., L.,372-376).

“during form (registration) or something they should have gave us a time to talk to everyone because not everyone’s going to listen to you because if you don’t really know someone that well then they’re just going to be ... not really listening to you. So if someone allocated us a time to talk about things people have to listen then it would be a bit different because then they’d actually take it in” (LFG3.8., P6., L.,241-247).

Moreover, the Peers that were engaged by the Leaders preferred receiving PA information from friends because they were more relatable and approachable compared to teachers. However, some Peers disagreed and stated how they preferred PA information from teachers, as they are a more reputable source of information and thus, more reliable.

“I think a balance between friends and teachers is like quite a good... your friends speak to you you’ll get the information, but you won’t get as much information from your friends as you do from the teachers” (PFG3.9 P2., L.,46-50).

Several Peers remarked how a combination of sources, both friends and teachers, may be the best approach as they are more likely to listen to friends and respect the teachers' subject knowledge more. Furthermore, the Leaders only discussed with their close friends the development of a new after-school programme. Peers reported that they were unaware of a new upcoming after-school club and had not been asked for their input. Several Peers did remark however that the current after-school club climate has clear gender biases "girls cricket or girls basketball they don't do either of them" (PFG3.2 P6., L., 186). Peers reported the desire to partake in after-school club activities with their male friends. These however, were only available to boys and the lack of choice of non-competitive after-school activity was a barrier to the Peers' PA engagement.

6.3.2.3.1. No Club School Summary

There were two overarching themes emanating from the data from the *No Club School*, which were Leader Development and Friendship Groups. The Leaders developed their knowledge and understanding of PA and their leadership skills as a result of the G-PACT project. The Mentor to Leader relationship demonstrated feasibility and acceptability of this intervention approach. However, membership in a certain friendship group dictated Peers' engagement in the project. Depending on what friendship group their Peers were part of; Peers were either engaged or unaware of the main G-PACT project components. There was a breakdown in communication between Leaders and the wider group of Peers. The Leader to Peers relationship was feasible, however refinements to the process were needed to engage a wider group of Peers, beyond the Leaders' close friends. The Leaders may have benefited from

additional PA opportunities to help promote greater PA engagement within their friendship groups.

6.3.2.4. Mentors Themes

There were four main themes arising from the Mentors focus groups: Time to Develop; Leader Selection; School Space; and Project Structure.

Time to Develop

Mentors reported that they took some time to develop into their roles. They were nervous at the start because the G-PACT project was important to them but grew in confidence as the project progressed.

“Your confidence develops, you're getting familiar with your role and things like that ... the more and more you do it, the more confident you get” (MFG5., P4., L99-102).

At the start of the G-PACT project, a common difficulty encountered by Mentors was building rapport with the Leaders, which was consistent across all schools. Building rapport was easier for some Mentors than others but there was consensus that this process took time to develop. Once the Mentors had conducted a few sessions with the Leaders and started to get to know them more on a personal level this rapport developed. Mentors specifically noted the importance of sharing their own personal experiences of PA, sport, and university with the Leaders.

“just being a role model and just showing them, "Oh", maybe introduce myself more and say, "I do this, I play this sport, I really enjoy this", and by doing that, you kind of break down a barrier where girls feel comfortable to look up to you, but also to talk to you about activity” (MFG2., P16., L555-560).

The Leaders responded well to these discussions and this supported the development of rapport between Mentors and Leaders. Additionally, Mentors reported that it may have been easier to build rapport with the Leaders if there were fewer Leaders in each school so they could work closer with a smaller group.

The Mentors commented that it took time to develop the best methods to interact and communicate with Leaders. Mentors reported having to find a balance between being friendly, mentoring, and delivering some important PA information.

“It was just difficult to try and find a balance on how to be with them. You want to be fun, and you want to be friendly and nice, but you also want to make sure that they're getting things done” (MFG3., P15., L500-506).

They noted having to act as a teacher at some stages especially when delivering the PA information. They also had some behaviour management issues with the Leaders in the Class and *No Club* schools in which they had to adopt a more authoritative position. Mentors wanted to create a relaxed and positive atmosphere of the Leaders to feel comfortable and develop. This again took time to develop in all schools but, was achieved in the *Choice* and *No Club* schools sooner than the *Class* school.

3.5.2. Leader Selection

The Mentors mentioned the importance of leadership selection to the feasibility of the G-PACT project. Leaders in the *Choice* and *No Club* school were cited as being passionate about their role and fully engaged in the leadership process. However, Mentors reported that the leadership selection in the *Class* school may have negatively influenced the G-PACT project.

“a few of the girls kind of would sit there and talk in their own little groups, but then have like an attitude about them that they didn't want to be involved, but they'll influence everyone else, so then they don't want to be involved” (MFG3., P7., L215-217).

Some Leaders in the *Class* school were not engaged, not interested and proved difficult to interact and build rapport with. However, the majority of the Leaders showed good leadership qualities and responded well to the guidance and support from their Mentors.

“they actually called a Year 9 assembly, and the Leaders actually stood up and delivered stuff on how to get more active and advertised the new club” (MFG6., P14., L447-452).

Mentors reported the Leaders in the *Choice* school fully embraced their role and actively tried to find new ways to encourage their Peers to engage in more PA and attend the new after-school programme. Mentors noted the *Choice* school Leaders showed great development and independence in their roles as the G-PACT project progressed.

School Space

The provision of suitable space to conduct the leadership and educational session was noted as a problem across all schools. This was linked with 'Teacher Engagement'; there were numerous accounts provided by the Leaders demonstrating insufficient facilities being provide for them to deliver the sessions in the manner they had planned.

"We made it as fun as we could, but there was nothing that we could have done, because we didn't have the space for it" (MFG3., P8., L266).

The Mentors had to adapt and, at times, find their own space (classroom, sports hall, changing room) in the school to conduct the sessions. Although the G-PACT project did not involve any direct input from teachers, Mentors noted how it would have been useful for the teachers to be there as the start of each sessions to support the G-PACT project and ensure a suitable space was provided within the school.

Project Structure

Mentors reported that the G-PACT project would have benefitted from a longer duration. Mentors note that both they and Leaders fully developed into their roles towards the end of the G-PACT project and would have benefitted from a longer period of time to work with the Leaders once they had built a strong relationship with them.

"It should have gone on for longer. I think a school year would have been great. Maybe like once every two weeks, just so it's not like once every week a session, and then after school clubs every week" (MFG4., P22., L742-745).

Mentors believed that having more time at the start of the G-PACT project dedicated to building rapport with the Leaders would have been very useful and benefitted the overall project. Mentors suggested distributing less PA information at the start of programme and spreading this information out across more sessions. Mentors also noted that the session on 'barriers to PA' was particularly useful and would have been more beneficial had it been delivered earlier in the programme.

Mentors commented that they could have done a better job at tracking the Peer engagement. Mentors remarked that they could have pushed the Leaders a bit more to go outside of their comfort zones and interact with Peers who were not their direct friends.

"They told us, I think, what they thought we wanted to hear, whereas I'd rather have them just been completely honest, because then it would have maybe altered what we did, whereas instead they're going, "Yes, yes, I've spoken to the girls in my form". Like we know that they didn't, but they're saying, "Yes, yes". Like they all handed out leaflets, but whether they handed them out and they got shoved in the bottom of their bag and not even looked at, it's like just a ... But they're Year 9 girls, so you're not going to get miracles out of them, are you?" (MFG3., P18., L619-625).

They did informally track the Peer engagement but got the perception that Leaders told them what they wanted to hear. Furthermore, Mentors indicated that after witnessing the benefit of an after-school club in the *Class* and *Choice* schools, the *No Club* school would have benefitted from a PA component to assist the Leaders with Peer engagement. Mentors believed the G-PACT project structure in the *Choice* school was the most feasible and acceptable model, as the Leaders were fully engaged in their activities and had autonomy over the after-school club activities. As previously discussed, across all schools the 'Teacher Engagement' could have improved. Mentors noted that they were a trusted source for after-school club information and could have helped with the after-school club advertisement and recruitment.

6.3.2.4.1. Mentors Summary

There were four main themes arising from the Mentors focus groups: Time to Develop, Leader Selection, School Space, and Project Structure. The Mentors needed time to develop into their role, grow in confidence and build rapport with their Leaders. The Mentor to Leader approach was feasible and acceptable from the Mentors perspective, but the relationship would have benefitted from a greater amount of time to develop into the roles and build rapport. The Leadership selection was important to the engagement of Leaders and Peers. Schools that selected appropriate Leaders benefitted most from the G-PACT project. This highlighted a vital element critical to the feasibility of this approach, the leadership selection of girls that are willing to engage and are enthusiastic about their roles. Across the three schools, the provision of suitable spaces to conduct the intervention activities was insufficient. The G-PACT project was feasible when conducted over a 7-week period but could have

benefitted from minor amendments to the structure of the leadership and educational sessions. Moreover, the intervention may have been more effective over a longer duration to allow more time for Mentors and Leaders to develop into their roles.

6.3.2.5. Comparison and Integration of Themes

There were themes identified in each school that closely related to themes from other schools or mentor data (Table 6.2.). The schools that selected Leaders who engaged in their roles and had a good understanding of their responsibilities benefited most from the intervention. Influential Leaders in the *Class* school hindered the relationship building process between Mentors and Leaders and thus, negatively influenced the implementation of the intervention. Leaders in the *Choice* and *No Club* schools in comparison, were able to build strong relationships with their Mentors although rapport did take some time to develop. This may have been due to the personal qualities and engagement levels of the Leaders in the *Choice* and *No Club* schools. The Leaders who engaged with the leadership and educational training sessions developed their PA knowledge, confidence and leadership abilities.

Table 6.2. Summary of themes for each school and Mentors alongside supporting raw data quotes.

Class School	Choice School	No Club School	Mentors
Engagement <i>"messages haven't filtered down enough (to the Peers)" (TI1., P5., L156).</i>	Leader Engagement <i>"it was hard to motivate people to come (to after-school club). Like you have to try and like persuade some people to come, like bribe them (laughs)" (LFG2.7., P1., L42).</i>	Leader Development <i>"I have learnt how to be more confident about leading a group of people in a sports activity. I have also learnt to help my friends get involved with activity. I have also learnt to encourage people more whilst doing activity and to get people to do more activity." (POQ3., P8., L177).</i>	Time to Develop <i>"Your confidence develops, you're getting familiar with your role and things like that ... the more and more you do it, the more confident you get" (MFG5., P4., L99-102).</i>
Mentor Rapport <i>"I don't know how much they made that connection with some of the Mentors" (TI1., P6., L197-202).</i>	Peer Engagement <i>"It's basically trying to encourage other students to do more physical activity to get healthy" (PFG11., P12., L347).</i>		Project Structure <i>"It should have gone on for longer. I think a school year would have been great. Maybe like once every two weeks, just so it's not like once every week a session, and then after school clubs every week" (MFG4., P22., L742-745).</i>
Leadership Selection <i>"we selected students that were potentially Leaders, but not sports Leaders, and then I've got the wrong mix of students," (I1., P1., L13-15).</i>	Leadership Role Clarity <i>"I've learnt lots of things about physical activity that I didn't know before and have been able to encourage my friends to get involved" (POQ2., P5., L212).</i>	Friendship Groups <i>"not everyone's going to listen to you because if you don't really know someone that well then they're just going to be ... not really listening to you. So if someone allocated us a time to talk about things people have to listen then it would be a bit different because then they'd actually take it in" (LFG3.8., P6., L.,241-247).</i>	Leadership Selection <i>"they actually called a Year 9 assembly, and the Leaders actually stood up and delivered stuff on how to get more active and advertised the new club" (MFG6., P14., L447-452).</i>
After-school Club Advertising <i>"I went to the club and it was a bit boring at first but it got better. It definitely helped me to do more physical activity" (POQ. P2., L14).</i>	After-school Club Environment <i>"because they had a choice of like new activities to do, that was more appealing to them" (TI2., P1., L9-10).</i>		School Space <i>"We made it as fun as we could, but there was nothing that we could have done, because we didn't have the space for it" (MFG3., P8., L266).</i>

However, across all three schools there was breakdowns in communication between Leaders and the wider group of Peers. The Leaders' communication with their Peers appeared to be dependent on associations with friendship groups. The Leaders in the *Choice* school were engaged and had a clear role clarity. When compared to the *Class* school, Leaders struggled to build rapport with their Mentors and teachers commented that the Leaders selected lacked the appropriate skills and quality to lead. This may have contributed to the poorer Peer engagement in the *Class* school compared to the *Choice* school.

For the two schools that received an after-school club component, these were generally well advertised by Leaders and subsequently well received by Peers and Leaders. The girls in the *Choice* school especially enjoyed the after-school activities as they had some autonomy over the choice of activity. Not having an after-school PA opportunity in the *No Club* school impeded the Leaders ability to encourage their Peers to engage in more PA during the intervention period. Overall, the intervention showed feasibility and acceptability for the relationship between Mentors and Leaders. The relationship between the Leaders and Peers to communicate PA messages requires refinement to improve effectiveness, but it is not unfeasible. The peer-led mentoring approach alongside an after-school PA opportunity and was feasible and acceptable in a secondary school setting.

6.3.2.6. Refinements

Table 6.3. Refinements to G-PACT intervention based on the thematic analysis, presented by school and mentor data.

Class School	Choice School	No Club School	Mentors
Taster PA session	Taster PA session	After-school PA component needed	Greater focus on Leaders engagement across all Peers
Engage all Peers with structured sessions so Leaders can access wider group	Engage all Peers with structured sessions so Leaders can access wider group	Engage all Peers with structured sessions so Leaders can access wider group	Greater focus on Leaders engagement across all Peers
Leadership selection revision	Assess friendship networks to access more peers	Assess friendship groups as key to intervention exposure	Leadership selection revision
	Longer intervention duration		Longer intervention duration
Clearer project identity from the start of project	Clearer project identity from the start of project	Clearer project identity from the start of project	
Greater provision of additional PA opportunities	Greater provision of additional PA opportunities		Greater provision of additional PA opportunities
Greater focus on rapport development between Mentors and Leaders	More time to develop rapport with Leaders at start of project	More time to develop rapport with Leaders at start of project	More time to develop rapport with Leaders at start of project
Make Leaders more identifiable to Peers	Make Leaders more identifiable to Peers	Make Leaders more identifiable to Peers	After-school PA component needed for all schools
During school day intervention sessions for leaders	More teacher involvement		Appropriate space provision in schools to run sessions

As illustrated in Table 6.3. there are refinements to the G-PACT intervention that are applicable across schools. It is evident that the leadership selection method requires improvement. Leaders with influence over fellow peers should be considered carefully before selection. Leaders with enthusiasm and a passion for leadership and a willingness to be involved in extra-curricular activities appeared to be best suited to the leadership roles in the G-PACT project. Taster Leadership sessions could be provided for the potential Leaders to assess their willingness to do the role and their suitability before giving them the responsibility and leadership training programme. These taster sessions would ensure that the Leaders have, (1) more time to build rapport with Mentors, (2) greater 'buy in' from the start of the programme, and (3) clearly understand their roles and responsibilities in-depth before starting the programme. Additionally, it is apparent that across all schools there is a greater need for a clearer project identity or branding from the start and this is related to making the Leaders more identifiable to their Peers from the start of the intervention.

In order to increase the effectiveness of the programme and ensure consistency across all participating schools, greater support for Leaders in their role is needed including: greater teacher involvement; more sessions during the school day; structured sessions whereby Leaders can directly communicate with the wider group of peers; and importantly a greater provision of PA opportunities to support peer engagement. A longer intervention duration could be considered and this would support the rapport development between Mentors and Leaders. These refinements would ensure that future programmes of the G-PACT project do not encounter similar issues.

6.4. Discussion

The aim of the study was to evaluate the feasibility and acceptability of a school peer-led mentoring intervention designed to increase PA levels and reduce ST of adolescent girls. The study found that the intervention was feasible and acceptable for adolescent PA Leaders and their Mentors but the relationship between Leaders and their Peers requires refinement to improve the communication processes. The use of an additional PA component in combination with the peer-led mentoring approach was feasible and acceptable in a secondary school setting.

This intervention was informed by previous research, underpinned by theory (SDT and SCT) and was multi-component in nature, as recommended to increase adolescent girls' PA levels (Corder, Brown, et al., 2016; Corder et al., 2015; Owen et al., 2017). The intervention builds on previous PA peer-led approaches with adolescents (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Harrington et al., 2018), incorporating university students as Mentors to provide guidance and support to PA Leaders. This study is one of the few to use a methodological approach that enabled researchers to capture data from all key stakeholders and the triangulation of data sources allowed for a comprehensive evaluation of both intervention feasibility and acceptability (enjoyment). The methodological approach and triangulation of data sources provides the study with a high degree of credibility and methodological rigour (Noonan et al., 2016). It was feasible to collect and analyse all data within a 6-month period. However, more time with the students to conduct the focus groups would have increased the depth to the qualitative accounts but this was restricted by timetabling and lesson time within the schools.

This intervention was implemented to be peer-led thus, it had a high degree of flexibility, including multiple interactions between Mentors, Leader and Peers. Therefore, this intervention can be classified as complex (Craig et al., 2008). In accordance with the MRC guidelines for developing complex interventions this feasibility study achieved its primary aim to assess the acceptability of this intervention approach (Craig et al., 2013). However, it is expected that for the development of complex interventions there should be a period of refinement before pilot testing to assess the likely rates of recruitment and retention of subjects, and the calculation of appropriate sample sizes. Numerous potential modifications were identified that need to be addressed before upscaling. These included adapting the Peer engagement processes, leadership selection process, rapport building process for Mentors and Leaders and provision of PA opportunities.

The results identified a breakdown in communication between Leaders and the wider group of Peers. Leaders focused on delivering PA messages to their friendship groups, which highlights a limitation with this intervention approach that needs to be addressed in subsequent implementation. This was confirmed from data from teachers, Mentors, Leaders and Peers. If the Leaders only interacted with their friends and, where appropriate, encouraged them to engage in new after-school PA opportunities, this could have led to some Peers feeling isolated or unengaged. This relates to the Social Identity Theory (Tajfel, 1974; Tajfel & Turner, 2004), whereby it may have been difficult for some Peers to identify or relate to the Leaders and their friends. These Peers may have considered themselves as part of an out-group (a social group with which an individual does not identify) and therefore, unable to participate

in the intervention components with the in-group (a social group to which an individual identifies as being a member) (Tajfel, 1974; Tajfel & Turner, 2004).

However, this disconnect between Leaders and Peers was less apparent in the *Choice* school. Leaders in the *Choice* school attempted to create one in-group through utilizing their role to inform fellow Peers at an assembly about PA and the new after-school club programme. The connection between Leaders and Peers may have been stronger in the *Choice* school due to the Leaders having greater autonomy over the intervention PA component. Autonomy was built into the intervention design through the SDT (Deci & Ryan, 2002). The PA component in the *Choice* school provided Leaders with the opportunity to engage with their Peers and suggest activities they may enjoy, creating a more inclusive in-group and more self-determined environment. Furthermore, supporting the Leaders, providing them with a degree of independence, and a structured opportunity to access all Peers may have positively influenced the social identification and comparison processes and subsequently increased group engagement (Tajfel, 1974; Tajfel & Turner, 2004).

Many previous peer-led PA interventions with other populations have included structured methods of delivery including, formal advice giving and leading educational classes (Ginis et al., 2013). By design, the current G-PACT intervention provided no formal structure for the Leaders to interact with their Peers. Similarly, others have used more informal methods to deliver health promotion messages in peer-led interventions (Bell, Audrey, Cooper, Noble, & Campbell, 2014; Campbell et al., 2008). The ASSIST (A Stop Smoking in Schools Trial) intervention adopted the Diffusion of Innovations Theory (Rogers, 2010) and applied its concepts to informally diffuse stop

smoking messages through social groups (Campbell et al., 2008). The intervention was effective in reducing smoking rates in adolescents compared to a control group. However, this informal approach may have not been wholly appropriate for the G-PACT intervention. The lack of intervention structure could have contributed towards a lack of clarity in the G-PACT intervention and communication breakdown in dissemination of key PA messages. A more structured formal approach, such as Leaders delivering structured sessions to peers in addition to the informal communications between friends warrants further exploration. Furthermore, future peer-led interventions with mentoring components should consider more extensive and structured guidance from the Mentors to the Leaders to reduce the ambiguity in their role and improve the intervention implementation.

Another possible contributing factor to the breakdown in communication was the Leaders personal attributes. The leadership selection process was highlighted across all schools as an aspect that could be refined to improve the intervention implementation. Although set criterion were provided to guide teachers' selections of the Leaders (i.e. access to multiple peers and did not have to be perceived as sporty etc.), some were not engaged in the leadership role. Previous interventions applying peer-led approaches (Bell et al., 2014; Campbell et al., 2008), and the planned PLAN-A (Sebire, Edwards, Campbell, et al., 2016) adolescent girls PA intervention, have utilized a peer nomination process to identify 'influential' peers who would be subsequently invited to be peer-leaders. However, the current G-PACT intervention found through the comparison of data sources, that some influential Leaders disrupted the leadership and educational programme, did not engage in the role

responsibilities and thus, may not be best suited for a PA leadership role. Leaders with a passion for Leadership, an interest in PA and a general enthusiastic attitude were well suited to the role.

Moreover, future leadership selection processes may consider investigating social networks before, during and post-intervention for peer-led approaches to assess the interactions between participants. Findings from a complex PA intervention using social network analysis found that those who exercised in pairs or a group maintained higher levels of PA than those who did not (Hunter et al., 2015). This provides support for peer-led approaches and the use of social network analysis to evaluate the intervention implementation and effectiveness. Similarly, the social network analysis may be a useful modification to the G-PACT intervention. This approach could be used to identify girls' friendship networks, inform leadership selection and tailor the Leaders role to target their friendship networks only to improve implementation.

The Mentor to Leader approach was found to be feasible and acceptable. The leadership and educational workshops, underpinned by SCT (Bandura, 1986, 1997, 1998) and SDT (Deci & Ryan, 2002), introduced behaviour change techniques to the Leaders (Michie et al., 2013) and provided leadership training to support their development. Health mentoring interventions have been found to be an effective tool to increase knowledge and PA in clinical populations (Schüz et al., 2015) but are understudied in youth. To the researcher's knowledge, health-mentoring interventions have not been combined with a three tier peer-led approach to increase adolescent girls' PA behaviours. These structured leadership and educational

workshops provided an opportunity for Mentors to build relationships and share experiences with their group of Leaders.

However, the Mentor to Leader approach could benefit from minor amendments. These include more time allocated to build rapport, greater detail on Leaders' roles responsibilities, and greater surveillance on the Leaders' engagement with peers, including an increased focus on barrier identification. Building rapport was commonly reported as a time consuming but an important process, Mentors felt that more time could have been dedicated to building this rapport to improve the mentor-leader relationship. A previous lifestyle based 'Go Girls' intervention (i.e. PA, nutrition, and wellbeing) including a mentoring component with adolescent girls found that the Mentors relationship with students was critical to the success of the intervention (Dowd, Harden, & Beauchamp, 2015). The findings illustrated the importance of the Mentors' ability to create a positive learning environment and sense of group belonging for the adolescent girls (Dowd et al., 2015). The G-PACT intervention was able to create a positive atmosphere for the adolescent girls but it took time to develop. In addition, the structure of the leadership and educational sessions did not allow a specified period to develop rapport between Mentors and Leaders, which should be considered in the future.

The refinements for the G-PACT intervention were solely based on findings from the current study. Some refinements show synergies with other peer-led programmes. For example, the Go Active intervention had a clear project identity from the start of the intervention (Corder, Brown, et al., 2016). Whilst this aspect may be influenced by funding available to advertise the project within the schools, the G-PACT intervention

advertisement could have been more comprehensive within the school environment and may have aided project engagement. However, there are also some distinct differences between the current refinements and previous peer-led programmes. Whilst the previous interventions had similar peer-led elements, the mechanism of delivery and intervention content differs in each programme. The G-PACT intervention delivery method had an extra component when compared to previous peer-led approaches (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Corder et al., 2015; Edwardson et al., 2015; Harrington et al., 2018; Sebire, Edwards, Campbell, et al., 2016). The incorporation of university students as mentors for adolescent leaders provided an additional level of support and guidance for the leaders from a relatable source. This third-tier to the intervention model added an extra layer of complexity to the intervention in terms of practicality. However, the results and refinements suggest this approach was successful and well received.

Previous peer-led interventions have utilised teachers or researchers to deliver intervention content to the leaders. Whilst this may be arguably a more comprehensive approach as the leaders received training from more knowledgeable sources, there is little ongoing support for the leaders compared to the G-PACT intervention. The PLAN-A intervention (Sebire, Edwards, Campbell, et al., 2016) did have a top-up training session for leaders at intervention midpoint (5-weeks) in addition to the 2-day initial training but, did not have weekly support for Leaders as the G-PACT intervention. The mentoring component is novel and the refinements to the G-PACT study based on the current findings suggest developing this aspect further in future iterations of the G-PACT intervention. The Go Active intervention (Corder,

Brown, et al., 2016; Corder et al., 2015) rotated the Leadership role so that all students had the opportunity to lead, but in the current intervention, it was important to have the same leaders in order to build rapport with their mentors to support their development as highlighted in the refinements.

The Girls Active programme incorporated peer leadership as part of a multi-component approach to increase girls PA levels (Edwardson et al., 2015; Harrington et al., 2018). The Girls Active programme utilised a similar leader-to-peer mechanism to the G-PACT intervention but, asked leaders to volunteer for the positions (Edwardson et al., 2015). Similarly, both programmes did not require leaders to be 'sporty' but, be seen as leaders for non-sporting reasons and thus, have the potential to have a positive influence on their peers (Edwardson et al., 2015). The peer-led approach is still a developing method to target youth PA behaviours. It is understudied in relation to the involvement of university students as mentors and the long-term impact of these approaches. Furthermore, adolescents are susceptible to changes relating to new influences and interests, which can affect behaviour. Thus, ongoing peer research is warrant especially in relation to PA.

An additional PA component, implemented as a new after-school club, was feasible and acceptable. The *Choice* school after-school club, which provided girls with a choice over activities, was particularly well received. Providing choice and autonomy has been well established as a successful approach influencing youths' PA enjoyment and engagement (Brooks & Magnusson, 2007; Dishman et al., 2005; Mitchell, Gray, et al., 2015; Ryan & Deci, 2000). The SDT can be applied to understand the acceptability of this approach (Deci & Ryan, 2002). The choice element of the PA component created

a sense of ownership and control over the activity. Combined with the PA component not being competence based and accessible to all Year 9 girls this may have increased girls feelings of relatedness, competence and autonomy. In turn, contributing to more self-determined forms of motivation and subsequent engagement in ‘their own’ after-school activity programme.

Conversely, the *Class* school Leaders reported less independence and autonomy over the intervention. This may have been because the after-school PA component was prescribed by the research team based on previous exploration work. This lack of control and choice of activity may have decreased their sense of ownership and control, and subsequently decreased their motivation to disseminate information about the after-school club (Ajzen, 1991). Nevertheless, when compared to the data sources from the *No Club* school, the additional PA component was an important aspect, which gave Leaders an opportunity to encourage their Peers to engage in more PA. Moreover, multi-component PA interventions have been found to be more successful with adolescent girls (Owen et al., 2017; Pearson et al., 2015; Van Sluijs et al., 2007). Future implementation of the G-PACT intervention should at minimum, contain an additional PA component, preferably a choice based component providing greater autonomy (Deci & Ryan, 2002).

6.4.1. Strengths and Limitations

A strength of the study was the triangulation of data, collecting perspectives from multiple sources, and using multiple methods to assess the intervention feasibility including conducting focus groups with all available Peers. This provides the results with greater credibility, dependability and trustworthiness. The qualitative

methodology allowed for the collection of contextual information to support the assessment of the feasibility and acceptability of the G-PACT intervention (O’Cathain et al., 2015). The study was innovative by way of its design, incorporating university students as mentors and potential role models within a three tier peer-led mentoring model. The use of older Mentors with an interest in and knowledge of PA provided Leaders with a relatable role model. The intervention was underpinned by multiple theories as recommended for intervention implementation (Kok, Schaalma, Ruiter, Van Empelen, & Brug, 2004) and effectiveness (Camacho-Minano et al., 2011; Owen et al., 2017; Pearson et al., 2015).

A limitation of the study is that some of the leadership and educational sessions for the Leaders were delivered within the school day and others after school. The pragmatic nature of the intervention, school timetable constraints, requirements and availability of Leaders dictated that these sessions required a degree of flexibility, which could not be controlled for across schools. However, this pragmatic approach demonstrated feasibility of implementing this type of intervention and allowed schools intervention flexibility, which is important in fluid environment such as schools (Naylor, Macdonald, Zebedee, Reed, & McKay, 2006). Additionally, school timetable constraints precluded a greater period of time being made available to conduct the focus groups. Due to resource constraints, Mentors worked across all schools and were not blinded to the different intervention approaches. However, this provided them with an informed perspective to compare and contrast intervention approaches and implementation.

6.4.2. Conclusion

The combination and comparison of data sources from Peers, Leaders, Mentors and teachers revealed that the G-PACT intervention was feasible and acceptable. However, the intervention requires a series of modifications and refinements before pilot testing and upscaling. The data confirms that the link between the Mentors and Leaders was feasible and acceptable. The leadership and educational workshops were well received by the Leaders, supported their leadership development. There was a breakdown in communication between Leaders and their Peers, which requires modification to improve the effectiveness. The use of an additional PA component in combination with the peer-led mentoring approach was feasible and acceptable in a secondary school setting. A choice based PA component should be implemented with adolescent girls providing them greater PA enjoyment and autonomy over their behaviours.

Chapter 6 Conclusion

The research article presented in this chapter was informed by findings from Chapters 3 and 4. Chapter 3 illustrated the importance of underpinning interventions with adolescent girls with behaviour change theories and ensuring that interventions are multi-component in nature. In Chapter 4, girls highlighted the importance and impact of friends on their PA experiences and enjoyment. This contributed towards the development of a novel approach to target adolescent girls' PA behaviours. This innovative intervention combining cross age mentoring with a peer-led approach

showed feasibility and acceptability. Although the communication processes between Leader and their Peers requires modifications, the article present above demonstrates the potential of this approach to utilise friendship networks to promote and positively influence PA behaviours with this population. The choice-based after-school club, developed directly from the findings from Chapter 4, was well received by the girls in the *Choice* school and should be strongly considered in future replications and upscaling of the G-PACT project. The leadership selection process should be carefully considered in future peer-led interventions, as their impact could both positively and negatively influence the intervention implementation, as illustrated in the current article. The findings from Chapters 5 and 6 raise some important discussion points, providing an overall perspective on the feasibility, acceptability and effectiveness of the G-PACT intervention that will be discussed in Chapter 7.

Thesis Study Map

Study	Objectives and Key Findings
Study 1 - The Effectiveness of School-Based Physical Activity Interventions for Adolescent Girls: A Systematic Review and Meta-analysis	Objectives <ul style="list-style-type: none"> - Assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. - Systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis.
	Key Findings <ul style="list-style-type: none"> - The meta-analysis indicated a small but significant positive effect of school-based interventions on adolescent girls' PA. - Sub-group analyses indicated small but significant effects for multicomponent interventions and interventions underpinned by theory.
Study 2 - Investigating Adolescent Girls' Perceptions and Experiences of School-Based Physical Activity to Inform the Girls Peer Activity (G-PACT) Intervention Study	Objectives <ul style="list-style-type: none"> - Qualitatively explore adolescent girls' understanding of PA - Explore adolescent girls' experiences of and perceptions towards engagement in school-based PA. - Explore adolescent girls' beliefs about factors important to facilitate PA engagement.
	Key Findings <ul style="list-style-type: none"> - Girls with lower levels of activity desire more non-competitive PA opportunities within the school setting and perceive the after-school club environment as being for sporty girls only - Regardless of activity level, girls gained greater enjoyment from PA when participating with friends and having greater autonomy over activity within the school setting.
Study 3 - The Feasibility of a Novel School Peer-led Mentoring Model to Improve the Physical	Objectives <ul style="list-style-type: none"> - Assess the feasibility of recruiting and retaining adolescent girls to a school peer-led mentoring intervention.

Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project	<ul style="list-style-type: none"> - Examine the feasibility of collecting accelerometer data to examine the PA levels and ST of adolescent girls. - Assess if a peer-led mentoring model can impact adolescent girls' PA levels and ST.
<hr/> Key Findings <ul style="list-style-type: none"> - It was feasible to recruit and retain adolescent girls to the school peer-led mentoring intervention. - The peer-led mentoring model in combination with a fitness class based PA after-school club increased girls' whole day and school day MVPA levels. - The peer-led mentoring model alone did not appear to positively impact girls PA levels. <hr/>	
Study 4 - The Feasibility and Acceptability of The Girls Peer Activity (G-PACT) Peer-led Mentoring Intervention	Objectives <ul style="list-style-type: none"> - Assess if a school peer-led mentoring intervention with an educational component was feasible and acceptable for adolescent PA Leaders. - Examine if a peer-led mentoring intervention was feasible in communicating PA messages with adolescent girls (13-14-years old). - Assess if a peer-led intervention with educational components in combination with PA opportunities was feasible and acceptable in the secondary school setting. <hr/>
Key Findings <ul style="list-style-type: none"> - The intervention was feasible and acceptable for adolescent PA Leaders and their Mentors but the relationship between Leaders and their Peers requires refinement to improve the communication processes. - The use of an additional PA component in combination with the peer-led mentoring approach was feasible and acceptable in a secondary school setting. <hr/>	

Chapter 7

Synthesis of Findings, Recommendations and Conclusions

7.1. Synthesis of Findings

The overarching aim of the research programme was to investigate the effectiveness of school-based PA interventions for adolescent girls and assess the feasibility, acceptability and effectiveness of a novel school-based peer-led PA intervention to increase PA levels and reduce ST of adolescent girls. This aim was assessed through five Research Questions:

1. What are the current PA and ST patterns of adolescent girls?
2. Are previous school-based PA interventions for adolescent girls' effective in increasing PA levels?
3. Is a peer-led mentoring model with educational and PA components feasible and acceptable in the secondary school setting?
4. Is a peer-led mentoring model feasible in communicating PA messages with adolescent girls?
5. Can a peer-mentoring model be effective in increasing adolescent girls' PA levels?

The programme of work firstly aimed to establish the effectiveness of school-based PA interventions for adolescent girls and identified key components important to their success. Secondly, a formative exploration was conducted to assess the current school environment and obtain girls' perceptions and experiences of school-based PA opportunities. Thirdly, based on these mixed methods findings and previous literature, a novel peer-led intervention was developed (G-PACT Project). This innovative approach incorporated university students to act as mentors to adolescent PA leaders. This mechanism provided adolescent girls with a support structure and

potential role model to guide their leadership role. As part of their leadership role, leaders were asked to encourage, support and promote positive PA behaviours to their peers. The intervention also incorporated additional PA opportunities within the school setting for girls. This approach has not been previously trialled in England thus; a mixed-methods evaluation was needed to test its feasibility, acceptability and effectiveness.

The programme of work was supported by the following three theoretical frameworks. The socio-ecological model (McLeroy et al., 1988; Sallis et al., 2015) provided a comprehensive framework to understand the multiple and interacting elements girls PA behaviours. The SCT (Bandura, 1986, 1997, 1998) allowed for the assessment of girls personal, behavioural, and social environmental to better understand how girls' acquire and maintain positive PA behaviours. SCT has been found to be a useful framework to explain PA behaviour (Young, Plotnikoff, Collins, Callister, & Morgan, 2014). The SDT (Deci & Ryan, 2002) provided a greater understanding of girls' PA motivation and how levels of motivation can be socially influenced through three basic psychological needs: autonomy (control, choice), relatedness (closeness to peers) and competence (perceived ability to complete task). The SCT and SDT underpinned the G-PACT intervention, few other peer-led approaches had been underpinned by appropriate theory (Ginis et al., 2013).

Although school-based interventions are promoted as the most promising setting to increase girls' PA levels (Camacho-Minano et al., 2011; Pearson et al., 2015), the findings from **Chapter 3** reveal that they have only a small effect (Owen et al., 2017). This finding answers Research Question 2, that school-based PA interventions for

adolescent girls are effective in increasing PA levels but only have a small impact. Sub-group analyses in **Chapter 3** revealed greater effectiveness for PA interventions underpinned by theory and multicomponent designs. Theory-based interventions have been consistently identified as effective approaches for targeting PA behaviours in both children and young people (Pearson et al., 2015; Van Sluijs et al., 2007), and adults (Gourlan et al., 2016). Similarly, long-term interventions that utilise a theoretical model or framework have been found to be effective in producing this sustained impact on PA with adolescents (Lai et al., 2014). However, the findings in **Chapter 3** indicated only small effects for these intervention designs, which highlights the difficulties of increasing PA levels among adolescent girls. A more realistic target for these long-term interventions may be slow or stop the decline in girls' activity levels (Dumith, Gigante, Domingues, & Kohl, 2011). The findings from this chapter were used to directly inform the design of the G-PACT intervention presented in **Chapter 5**.

Chapter 4 aimed to explore adolescent girls' perceptions and experiences of school-based PA and investigate how school-based PA opportunities could be improved to meet their needs. This chapter was a formative evaluation of the current school environment to inform the development of a complex intervention, as recommended by the MRC (Craig et al., 2013). The exploration study revealed differences in perspectives of school-based PA based on participants' overall level of PA. The after-school PA environment was dominated by competitive sports with little opportunity for girls to try new activities or sports who were not part of school teams.

Regardless of activity level, girls reported greater enjoyment from PA when participating with friends and having greater autonomy over the activity.

These findings from **Chapter 4** directly informed the development of the after-school components in **Chapter 5**. One after-school club component was developed to contain a high level of autonomy through the provision of choice over activities. The fitness class-based component was designed to give girls the opportunity to engage in a new non-competitive after-school club. Previous research has illustrated the importance of choice to positively influence girls' PA experiences in school (Mitchell, Gray, et al., 2015). However, many schools lack the resources, facilities, time, or staffing to provide these opportunities as well as school sports programmes, which usually take priority (Naylor et al., 2015; Turner, Johnson, Calvert, & Chaloupka, 2017; Van den Berg et al., 2017). Providing girls with greater autonomy through PE, allowing participation with friends rather than sporting competence could encourage greater enjoyment and subsequent engagement in PA both in and out of school (Dishman et al., 2005; Grieser et al., 2008).

7.1.1. G-PACT Intervention

The G-PACT intervention findings from **Chapter 5** answer Research Questions 1 and 5. The PA data collected from G-PACT illustrate the current PA levels of adolescent girls. Across the three schools girls averaged 27 minutes of MVPA per day with only 2% of girls achieving the recommended 60 minutes of MVPA guidelines (Chief Medical Officers, 2011). This is below the national average for 13-15 year old girls (9%) (Public Health England, 2016, 2017). Although, this figure was calculated using accelerometers and raw data analysis. Comparisons of the current data with self-

reported or other objective methods should be made with caution due to differences in the methodological processes and analyses (Freedson, Bowles, Troiano, & Haskell, 2012b; Hildebrand et al., 2017; Peach, Van Hoomissen, & Callender, 2014b). This is a limitation of PA research as a whole, as there is no consensus on processes for the measurement of PA thus, comparisons across and between different studies are difficult. Self-report measures are limited by recall bias and while objectivity measured PA does not eliminate bias, it can reduce sources of measurement and processing error (Nusser et al., 2012).

The results from **Chapter 5** illustrate that the innovative peer-led approach can increase adolescent girls' PA levels when combined with a fitness class-based PA component. However, findings from **Chapter 6** infer that some of the leaders in *Class* school did not fully engage in their roles and took a long time to develop rapport with Mentors. Therefore, it is difficult to distinguish the impact of the peer-led approach on activity levels compared to the impact of the additional after-school club.

Given the reductions in MVPA and increase in ST shown in the *No Club* school it is reasonable to assume that the peer-led approach needed to be used in combination with an after-school PA component to, at a minimum, maintain girls' PA levels. However, the after-school clubs had a limited uptake in both schools and the lack of a control group meant that it was difficult to assess if the change in PA was due to the after-school club, or its combination with the peer-led approach. In addition, the reduction in MVPA and increase in ST in the *No Club* school was significant. This could be due to multiple factors for example, the G-PACT intervention could have been poorly implemented, decreased motivation levels of girls or the data may have been

influenced by other school activities. These are all factors that could be explored if scaling up the intervention, especially the use of a process evaluation to allow implementation fidelity to be assessed (Moore, Audrey, et al., 2015).

The G-PACT findings from **Chapter 6** answer Research Questions 3 and 4. The combined data from Leaders and Mentors indicated that the intervention was feasible and acceptable for adolescent PA Leaders and their Mentors. The cross-age mentoring which has shown success in other health areas (Black et al., 2010; Campbell et al., 2008; Davey-Rothwell et al., 2011) was feasible in a school PA context and acceptable to adolescent girls. However, the data from all sources inferred that the communication between Leaders and their Peers required refinement to improve the coverage of intervention messages across all peers. Moreover, the use of an additional PA component in combination with the peer-led mentoring approach was feasible and acceptable in a secondary school setting. It was important to capture data from multiple sources to explore the consistency of girls' thoughts, perceptions, and experiences of the intervention. This allowed for the assessment of the feasibility and girls' enjoyment of the intervention. This comprehensive mixed-methods approach should be strongly considered in future work in this area.

The qualitative accounts from Leaders and Peers in **Chapter 6** suggest that the choice based after-school club component was the most acceptable and enjoyable type of after-school club. Although the *Choice* school showed no significant improvements in MVPA or ST, a choice based PA programme should be considered in the future by schools considering the relationship between enjoyment, intrinsic motivation and PA engagement (Budd et al., 2018; Gebremariam et al., 2012). Girls appeared to choose

less traditional forms of activity (i.e. dodgeball, trampolining and Zumba), which provided increased enjoyment and the opportunity for greater social interaction. Although this approach did not increase MVPA, it has the potential to engage girls in PA through positive and enjoyable experiences.

Due to the design employed, no follow up was conducted, as the main objective was to assess the feasibility and acceptability of the intervention. This precluded the evaluation of the sustainability of the intervention. Furthermore, this was a short-term intervention, and interventions are more likely to be effective when implemented over a longer duration (Lai et al., 2014). However, through utilising peer networks to implement the intervention, this method shows the potential to be continued in the school setting but requires further investigation.

Compared to other school-based peer-led approaches targeting adolescents PA behaviours (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Harrington et al., 2018; Sebire, Edwards, Campbell, et al., 2016) the G-PACT intervention includes the novelty of undergraduate students as mentors to adolescent girls. The G-PACT intervention utilised undergraduate students to provide adolescent girls with an approachable role model, who they could relate to, who also had subject specific knowledge. This provides a potentially sustainable model moving forward, based on the ready supply of university students seeking these development opportunities and the desire for schools to establish links with universities.

Other peer-led approaches have used coaches, teachers or older students to deliver intervention components. Whilst this approach may be acceptable and effective, the G-PACT intervention provides a structure to provide girls with support and mentoring

from girls who have recently gone through similar experiences to themselves. University Mentors can empathise with the challenges adolescent girls face both personally and academically. This aspect warrants further exploration in future work to assess the longer-term impact of the mentoring experience for adolescent girls.

The G-PACT intervention alongside previous peer-led approaches (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Harrington et al., 2018; Sebire, Edwards, Campbell, et al., 2016) highlights the importance of peer leadership with the adolescent population. Schools and policy makers should consider integrating more peer-led approaches into school practice in order to stimulate greater peer-learning and social support for PA. The peer-led approach is relatively cost effective after the initial development stages. For example, in the G-PACT project the resources were created by the lead researcher, the intervention tasks were designed to be conducted with minimal resources, and the peer mentoring element delivery of the intervention formed part of a work experience module for undergraduate students.

If schools can initially support the development of peer-led strategies, these then have the potential to be sustainable and cost effective in the long-term. However, there were multiple people involved in the delivery of the G-PACT intervention and the after-school club in the Class school required specialised training and a license to deliver. This would come at a significant cost and at the detriment of sustainability if implemented again. Although, the Class school activity was similar to a fitness-based gym class, an adapted version where no licence is needed could be utilised in the future. This may impact quality of delivery, but using undergraduate students with experience delivering gym fitness classes could compensate for this, and would be more cost

effective. Overall, the G-PACT intervention demonstrates that there are novel methods to incorporate relatively cost effective peer-led programmes into the school environment.

7.2. Strengths and Limitations

The strengths and limitations of each individual study have been discussed in detail in the discussion section of the relevant chapter. The strengths and limitations highlighted here will present the overall strengths and limitations of the programme of work.

Chapter 3 (Study 1) was the first to assess the effectiveness of school-based PA interventions for adolescent girls (Owen et al., 2017). The formative exploration allowed for an assessment of adolescent girls' current PA experiences and provided a platform for them to suggest improvements for future school-based programmes. Incorporating adolescents in the formative stages of intervention design has been found to be a promising strategy when used in obesity prevention interventions (Kornet-van der Aa, Altenburg, Randeraad-van der Zee, & Chinapaw, 2017). Furthermore, the exploration study allowed for adolescent girls' input to be considered and inform the G-PACT intervention design and implementation plan. This illustrated how the intervention was informed by the target group in order to increase the probability of positive intervention recruitment, engagement and efficacy (Craig et al., 2008), all challenges highlighted in previous studies (Naylor et al., 2015; van Sluijs & Kriemler, 2016). Traditionally there has been limited consultation with the target group identifying their needs and characteristics. This exploration process is a key strength of the programme of work.

Additionally, as part of the G-PACT intervention development, teachers provided their input and suggestions at a meeting with the research team. This process illustrated engagement with two key stakeholders (adolescent girls and teachers) leading to a collaborative approach to the design of the intervention that was research informed, practical in the school setting and accounted for the target populations' requests (van Sluijs & Kriemler, 2016). This was a valuable strength of the programme of work, which preceded the evaluation the novel intervention both quantitatively and qualitatively. This systematic approach is recommended when developing complex interventions (Craig et al., 2013).

The thesis was underpinned by behaviour change theory throughout; underpinning interventions with appropriate behaviour change theory has been consistently shown to increase intervention effectiveness (Naylor et al., 2015; Pearson et al., 2015; Van Sluijs et al., 2007). The SDT and SCT provided an appropriate framework to target girls' social influences and motivation to engage in PA. The programme of work adhered to the MRC guidelines for developing complex interventions throughout (Craig et al., 2013). This allowed for the identification of unexpected factors, which could influence intervention implementation and effectiveness. For example, the feasibility study highlighted the importance of the leadership selection process and use of an after-school PA club to encourage positive PA behaviours. The reporting of results in **Chapter 5** and **6** both followed the CONSORT extension guidelines for feasibility and pilot trials (Eldridge et al., 2016) to ensure consistency and rigour.

The mixed methodological approach is another strength of the programme of work presented. Using quantitative and qualitative methods allowed for the capture of both

objective and contextual data. The meta-analysis procedures utilised in **Chapter 3**, allowed for a comprehensive assessment of the effectiveness of past school-based interventions to increase PA. Whereas, the focus group technique used in **Chapter 4**, allowed for the assessment of contextual information relevant to the girls' current environment (O'Cathain et al., 2015)..

The G-PACT project employed a methodological approach that enabled researchers to capture PA data from all girls and contextual data from all key stakeholders. The qualitative approach collected perspectives from all sources pertinent to the intervention. The triangulation of data sources allowed for the comparison and confirmation of data, which provided the study with a high degree of credibility and methodological rigour (Noonan et al., 2016). Similarly, a comprehensive passive consent procedure was used to recruit participants for the G-PACT intervention. When compared to the active consent process used in **Chapter 4**, the passive consent approach was a and crucial element to the high recruitment and data collection rate in **Chapters 5 and 6**.

The quantitative approach in **Chapter 5** utilised wrist worn accelerometers and raw data processing to provide an objective estimate of girls PA levels. Wrist worn devices improve the wear time compliance with children and young people (Fairclough, Noonan, et al., 2016; Scott et al., 2017), and thus, reduce bias and provide more reliable estimates of PA (Toftager et al., 2013; Tudor-Locke et al., 2015). The raw data processing approach allowed the researcher greater control over the data processing and analysis to assess areas relevant to the specific aims of the intervention

and allows for comparability between studies (Freedson et al., 2012b; Peach et al., 2014b).

A limitation of the programme of work is that the intervention was implemented over a short period of time. Longer-term (>1 year) interventions have been shown to lead to greater effectiveness and have a sustained impact on adolescents PA levels (Lai et al., 2014). The key intervention messages could have taken time to filter down to the peers and positive intentions to be physically active could have taken time to develop into behaviours. This is mainly due to the passive nature of the peer-led approach, the time required for Leaders to develop into their role, and the time needed for the Mentors to build rapport with the Leaders. A greater intervention period or follow up could have been able to assess the changes in PA in the long term and provided Leaders and Mentor more time to develop into their roles.

Although the intervention presented was a feasibility study, a control group would have enabled the true impact of the intervention to be evaluated (Tai & Iliffe, 2000). The schools were not randomised due to resource and time restrictions to implement the intervention as planned, which increased potential bias compared to a cRCT design (Thomas et al., 2015). Additionally, this was the first-time schools in this geographical region had engaged in an intervention research project. This may have influenced participants' and teachers' behaviours and motivation towards the intervention. Schools were instructed to implement normal practice around the intervention material, but the impact of an intervention to increase PA levels and the development of a link with the local university could have influenced the teachers' practices in an effort to present the school in a more positive manner. The novelty of

wearing wrist worn accelerometers may have also influenced girls' normal PA behaviours.

There was no process evaluation of the intervention; therefore, it was difficult to determine whether the intervention activities had been delivered as intended. A process evaluation could be conducted when upscaling the interventions as the Go Active intervention had demonstrated (Jong et al., 2018). Implementation assessments are an important aspect of PA evaluations (Naylor et al., 2015). Checklists were used in the leadership and educational sessions as a measure to ensure consistency in delivery but the peer-led interactions were more difficult to assess. Furthermore, there was no assessment of the sustainability of the peer-led approach. The Mentors who delivered the intervention components to the adolescent Leaders were university students, thus their time was largely constrained by university timetables and workload. This warrants further consideration regarding the sustainability of this approach. Other similar interventions have used external coaches to deliver some intervention content (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Sebire, Edwards, Campbell, et al., 2016) but funding restrictions precluded their use in the G-PACT intervention. The feasibility of utilising university Mentors over a longer period of time and across additional schools (upscaling) is a potential limitation of the study design that also warrants further investigation.

The Leaders were chosen by the teachers with the support of criteria set by the research team for suitability for the leadership role. Although, this process was open to bias. Teachers could have picked girls they had good relationships with, or who had been involved in previous leadership programmes. It was identified in the

development of the intervention that it would be difficult to identify potential leaders. However, after discussion with the research team and in an effort to make an original contribution to knowledge, it was decided that the teachers would be best informed to make these decisions. Although this method worked well in some schools, in future a combination of teacher input and a measure of leadership (Campbell et al., 2008), peer nomination (Sebire, Edwards, Campbell, et al., 2016), or rotation of leaders (Brown, Whittle, et al., 2017; Corder, Brown, et al., 2016; Corder et al., 2015) could be considered.

A final limitation of the programme of work is that the exploration study used to inform the G-PACT intervention was relatively small. It was only conducted in one school and this school then participated in the G-PACT intervention. Only a small number of girls participated in focus groups due to parental consent issues and motivation to participate. However, this did then help inform the use of passive consent procedures in the G-PACT intervention that showed significantly high recruitment retention rates.

7.3. Recommendations for Practice

This programme of work identified several recommendations for practice to promote engagement in PA for adolescent girls. School practitioners have a significant role to play influencing girls' PA behaviours.

- Schools could offer more non-competitive and enjoyable after-school PA opportunities for girls to be engage in PA.
- Schools could consider self-selected peer groupings during PE and other physical activities in school to increase enjoyment and promote PA

engagement. Doing PA with friends has been shown to be more desirable to adolescent girls and more enjoyable.

- Consulting with girls to identify what PA programmes they desire and then implementing such programmes would be a simple yet effective method to engage girls in PA. Providing girls with the choice of activity and a degree of control over the activity may stimulate greater motivation and enjoyment to be physically active.
- Schools could consider the use of a fitness based class to increase girls' MVPA levels in PE or in an after-school club. These activities have been found to increase MVPA levels in adolescent girls, hence they are warranted in the school settings
- Schools could promote the use of peer-led approaches when trying to engage adolescent girls in new after school physical activities. These peer-led approaches allow girls to promote school PA opportunities within their friendship networks.
- School leadership programmes could look to provide leaders with a platform to speak to all their peers in a formal setting as well as through informal communications in order to aid the coverage of the programmes messages.

7.4. Recommendations for Future Research

As this programme of work included exploratory and feasibility components, the current findings infer numerous recommendations for future research to investigate girls' school PA behaviours.

- Future school PA interventions should be underpinned by appropriate behaviour change theory.
- Future school PA interventions should be multi-component in design.
- Future development of complex interventions with children and young people should ensure that they consult with the target group to identify their needs, perceptions, and experiences.
- An exploration study should be considered to assess the current environment and receive feedback from key stakeholders.
- Incorporating teachers in the development of school interventions is encouraged to ensure complex interventions are practical and have potential feasibility in the real-world setting.
- Future feasibility studies should incorporate quantitative and qualitative methods to provide objective and contextual information to best assess the feasibility of the tested approach.
- Carefully planned process evaluations should be strongly considered with complex interventions to assess implementation.
- Peer-led approaches should be incorporated in future school PA interventions alongside multiple opportunities for PA, including choice based and fitness elements.
- Future work may look to test the sustainability of the cross-age mentoring approach and may consider using older mentors within the schools, if timetabling allows.

- The use of peer-led approaches to target friendship networks when disseminating PA information should be further investigated with a detailed implantation plan.
- A modified version of the G-PACT intervention should be piloted before upscaling

7.5. Thesis Conclusions

The overarching aims of the programme of work were to investigate the effectiveness of school-based PA interventions for adolescent girls and assess the feasibility, acceptability, and effectiveness of a novel school peer-led PA intervention to improve the PA levels and ST of adolescent girls. The programme of work was conducted in a systematic manner to assess past interventions, evaluate current practices and implement a new school-based PA intervention for adolescent girls. It is evident that adolescent girls are not doing enough to achieve the multitude of health benefits that regular PA provides. Schools are a promising setting to intervene and promote PA with this population but, based on the findings of this programme of work, these interventions only have a small positive impact on girls' PA levels.

Novel interventions take time to develop, require significant planning, input from key stakeholders and need to be appropriately underpinned by theory. However, these novel interventions should be encouraged as they show promise in increasing adolescent girls' PA levels. The G-PACT intervention demonstrated the ability to incorporate cross age mentors to provide adolescent leaders with guidance and support to promote PA to their peers. There is potential for this method to be sustainable in the school setting and it has illustrated its effectiveness to increase PA

levels. Although, additional research based on the limitations highlighted above is necessary. A modified version of the G-PACT intervention warrants piloting before consideration on a larger scale.

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Appendix

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Appendix 1. Search strategies for each databased used.

Search strategy for PubMed

("physical activity"[Title/Abstract]) OR "physical activities"[Title/Abstract]) OR "physical education"[Title/Abstract]) OR exercise[MeSH Terms]) OR "sedentary behaviour"[Title/Abstract]) OR "sedentary behavior"[Title/Abstract]) OR "sedentary time"[Title/Abstract]) OR walking[Title/Abstract]) OR sport[Title/Abstract]) OR fitness[Title/Abstract]) OR sitting[Title/Abstract]) OR "screen time"[Title/Abstract]) OR "energy expenditure"[Title/Abstract])

AND

school*[Title/Abstract]) OR teacher*[Title/Abstract])

AND

classroom*[Title/Abstract]) OR gymnasium[Title/Abstract]) OR recess[Title/Abstract]) OR playtime[Title/Abstract]) OR “break time”[Title/Abstract]) OR playground[Title/Abstract]) OR lesson[Title/Abstract]) OR “before school”[Title/Abstract]) OR “after school”[Title/Abstract]) OR "sports hall"[Title/Abstract]

Filters: Publication date from 2006/01/01 to 2016/09/31; English

Search strategy for Web of Science

TS= ("physical activity" OR "physical activities" OR "physical education" OR exercise OR "sedentary behaviour" OR "sedentary behavior" OR "sedentary time" OR walking OR sport OR fitness OR sitting OR "screen time" OR "energy expenditure")

AND TS= (school* OR teacher*)

AND TS= (classroom* OR gymnasium OR “sports hall” OR recess OR playtime OR “break time” OR playground OR lesson OR “before school” OR “after school”)

Search language=English

Search strategy for Psych INFO

((TI physical activity OR AB physical activity OR KW physical activity) OR (TI physical activities OR AB physical activities OR KW physical activities) OR (TI physical education OR AB physical education OR KW physical education) OR (TI sedentary behaviour OR AB sedentary behaviour OR KW sedentary behaviour) OR (TI sedentary behavior OR AB sedentary behavior OR KW sedentary behavior) OR (TI sedentary time OR AB sedentary time OR KW sedentary time) OR (TI walking OR AB walking OR KW walking) OR (TI sport OR AB sport OR KW sport) OR (TI fitness OR AB fitness OR KW fitness) OR (TI sitting OR AB sitting OR KW sitting) OR (TI screen time OR AB screen time OR KW screen time) OR (TI energy expenditure OR AB energy expenditure OR KW energy expenditure))

AND

((TI school* OR AB school* OR KW school*) OR (TI teacher*OR AB teacher*OR KW teacher*))

AND

((TI classroom* OR AB classroom* OR KW classroom*) OR (TI gymnasium OR AB gymnasium OR KW gymnasium) OR (TI sports hall OR AB sports hall OR KW sports hall) OR (TI recess OR AB recess OR KW recess) OR (TI playtime OR AB playtime OR KW playtime) OR (TI break time OR AB break time OR KW break time) OR (TI playground OR AB playground OR KW playground) OR (TI lesson OR AB lesson OR KW lesson) OR (TI before school OR AB before school OR KW before school) OR (TI after school OR AB after school OR KW after school))

Search strategy for SPORTDiscus

((TI physical activity OR AB physical activity OR KW physical activity) OR (TI physical activities OR AB physical activities OR KW physical activities) OR (TI physical education OR AB physical education OR KW physical education) OR (TI sedentary behaviour OR AB sedentary behaviour OR KW sedentary behaviour) OR (TI sedentary behavior OR AB sedentary behavior OR KW sedentary behavior) OR (TI sedentary time OR AB sedentary time OR KW sedentary time) OR (TI walking OR AB walking OR KW walking) OR (TI sport OR AB sport OR KW sport) OR (TI fitness OR AB fitness OR KW fitness) OR (TI sitting OR AB sitting OR KW sitting) OR (TI screen time OR AB screen time OR KW screen time) OR (TI energy expenditure OR AB energy expenditure OR KW energy expenditure))

AND

((TI school* OR AB school* OR KW school*) OR (TI teacher*OR AB teacher*OR KW teacher*))

AND

((TI classroom* OR AB classroom* OR KW classroom*) OR (TI gymnasium OR AB gymnasium OR KW gymnasium) OR (TI sports hall OR AB sports hall OR KW sports hall) OR (TI recess OR AB recess OR KW recess) OR (TI playtime OR AB playtime OR KW playtime) OR (TI break time OR AB break time OR KW break time) OR (TI playground OR AB playground OR KW playground) OR (TI lesson OR AB lesson OR KW lesson) OR (TI before school OR AB before school OR KW before school) OR (TI after school OR AB after school OR KW after school))

Filter: English

Appendix 2. Quality assessment tool.

Types of mixed methods study components or primary studies in a SMSR context	Methodological quality criteria
1. Quantitative experimental	<p>Appropriate sequence generation and/or randomisation – describe the method used to produce sequence generation or randomisation in sufficient detail to allow an assessment of whether it should produce comparable groups. Must not just stated that sequence generation or randomisation has occurred.</p> <p>Allocation concealment and/or blinding – clear description/explanation of the allocation concealment or blinding process to the participant and/or assessor.</p> <p>Complete outcome data and/or low withdrawal/drop-out (<20%) – describe the participant retention rate from baseline to post-intervention to in order to assess if <20% reduction in sample size from withdrawal or dropout has been achieved.</p> <p>Appropriate outcome measure (PA) – Was an objective measure of PA used to measure activity.</p>
<p>1=* 2= ** 3= *** 4=****</p> <p>1= weak, 2= moderate, 3= strong, 4= very strong</p>	



Appendix 3. G-PACT intervention passive consent forms.

Gatekeeper Information Sheet

Title of Project: **Girls Peer ACTivity (G-PACT) Project**

Researcher Team: Michael Owen, Prof Stuart Fairclough, Dr Whitney Curry and Dr Charlotte Kerner

Your school has been invited to participate in a research study investigating Year 9 girls' physical activity. Regular physical activity is important for children's health and development but it is well known that most children are not active enough to benefit their health. The aim of the project is to improve health and wellbeing in West Lancashire girls through school-based physical activity interventions.

What will happen?

Firstly, the school will be asked to consent to the research taking part in their school with their students. Then the parents will be asked to consent to their child taking part in the study. All consenting students will attend school as normal on the days when data collection takes place. All students will be asked if they are still happy to take part, and researchers will remind the students that they can drop-out if they no longer want to take part. Students will be asked to complete questionnaires, complete some measurements and wear a physical activity monitor for 7 consecutive days. The measurements will be taken during school time and will take only a minimal amount of time to complete. All measurements will be managed and conducted by the research team who have enhanced DBS clearance. Teachers will be present during these activities. The following measures will be completed:

Questionnaires

Students will complete the questionnaires in a classroom. The questionnaires will relate to enjoyment of physical activity, health and wellbeing and social support. The questionnaires should take no longer than 20 minutes to complete. In the presence of a teacher, a researcher will read the students the same set of instructions for all questionnaires and assure the students that all responses will be kept anonymous and confidential. The researcher will answer any questions the students may have to ensure everyone fully understands what the questionnaires are asking.



Physical activity monitoring

A small activity monitor will be handed out to each child which will look very similar to a watch. Students will be shown how to wear the monitor and will be provided with an information sheet to read and share at home. This will include details of when and when not to wear the monitor. Students will wear the activity monitor on the wrist of their non-dominant arm. The monitors are small and light and are very unobtrusive (see image). Students will be asked to wear the monitors for 7 consecutive days during waking and sleeping hours, and to only remove them during water based activities, like swimming, showering, taking a bath, etc. After 7 days the researchers will come into school to collect the monitors.



Height, weight, and waist circumference

We will measure each child's weight, height and waist circumference. All of these measures will take place away from the rest of the group by a trained female researcher, and no one but the researchers will see the results. These results WILL NOT be fed back to the student, teachers or parents/carers. The results will be used anonymously for research purposes only. Weight will be measured by asking the child to stand on weighing scales with their shoes removed. Height will be measured using a height meter; each child will be asked to stand with their back to the height meter and the researcher will record the standing height values. A measuring tape will be used to measure the child's waist circumference.

Focus Groups & Interviews

To get their thoughts on physical activity and recent school based activity sessions, students may be asked to take part in a focus group (group discussion) with 4-6 of their classmates or in one-to-one interviews if they prefer. The focus group or interview will be held at school and will last no longer than 30 minutes. The session will be audio (voice) recorded on a dictaphone.



Are there any risks / benefits involved?

We are not asking students to participate in any activities that they would not take part in during a normal day (e.g. in P.E., at playtime, at sports practice, after school clubs) so risks are minimal. Students typically enjoy being part of these studies and undertaking the measurements and the experience of taking part may stimulate interest in health and fitness, and promote the adoption of healthy lifestyles.

Will the information collected be kept confidential?

All information about your students including their results will be treated with the strictest confidence. No identifiable information will be released by the project, and all data is securely stored by project staff, and may be accessed by approved persons only (i.e., the research team). It will be made clear to students that they can stop taking part in the study at any time they want, without explanation. Your students will not be forced to take part if they do not want to. During focus groups or interviews, if they do not want to answer a question, they have the right to refuse. Also, through contributing in the study the information gathered may help to inform future policies around school-based physical activity programmes.

This study has received ethical approval from Edge Hill University's Research Ethics Committee.

All researchers are DBS checked and will abide by the school's procedures regarding safeguarding. Please contact Michael Owen if there is anything that you are unsure about or need something explaining in more detail.

Contact Details of Lead Researcher & Supervisor

Lead Researcher: Michael Owen

- Michael.Owen@edgehill.ac.uk
- [Tel: 01695 657344](tel:01695657344)

Supervisor: Prof. S. Fairclough

- Stuart.Fairclough@edgehill.ac.uk
- [Tel: 01695 584143](tel:01695584143)



Leadership - Parent/Carer Information Sheet

We would like to invite your daughter to take part in a research project aiming to improve health and wellbeing in West Lancashire girls. Your daughter has been selected to take part in a leadership training programme to promote physical activity and wellbeing among adolescent girls. Your daughter will be asked to attend a training day at Edge Hill University, which will be organised through your daughter's school in partnership with the PE department, and will take place during school hours. There will then be a further six weekly training sessions based at their school. As part of the project girls, will be asked to take part in the following activities:

- **Leadership training** – attend sessions on leadership, physical activity, health and wellbeing, motivation and goal setting.
- **Questionnaires** – Surveys will ask girls about their experiences in each session and the overall project.
- **Focus groups and Interviews** - Questions will be asked about girls' thoughts on taking part in the leadership training programme and their thoughts on physical activity both in school and in after school clubs.
- **New after school club** – there will be a new afterschool activity club starting which your daughter will help develop as part of the leadership training programme. The girls in the leadership programme will be able to take part in these sessions if they want to, though this is not compulsory.

All information about your daughter will be treated with the strictest confidentiality. No identifiable information will ever be released by the project. All girls will be given a unique code which the research team will use instead of names. Data is securely stored and can be accessed by the research team only.

What do I need to do if I would like my daughter to take part in this study?

If you are happy for your daughter to take part in the project, you DO NOT NEED TO DO ANYTHING. All girls will be asked if they are happy to take part before the study starts and will be asked to sign a form to confirm this. Girls do not have to take part if they do not want to.



What do I need to do if I DO NOT want my daughter to take part in this study?

Your daughter does not have to take part. If you DO NOT want your child to take part in **some** or **all** of the project, please fill out the attached "*opt out form*" and return it to school (PE Department) as soon as possible. The project will start 09/01/17 but you can withdraw your child at any time, even after the project has started.



Thank you for taking the time to read this information. If you have any questions, please do not hesitate to get in touch. More detailed information about the project can be found at www.tinyurl.com/j522cg3

Contact Details of Researcher:

Michael Owen, Edge Hill University

Email: Michael.Owen@edgehill.ac.uk

Tel: 01695 657 344



Leadership - Parent/Carer Opt Out Sheet

If you are happy for your daughter to take part in all of the project, you do not need to do anything and do not need to send any forms back to school. You should only return and complete this form if you **DO NOT** want your daughter to participate in **some** or **all** aspects of the project.

Please tick the boxes below relating to any information or measures you do not want the research team to collect.

	I <u>DO NOT</u> want the following information/measures taken from my daughter: ✓
Leadership Training	
Questionnaires	
Focus Groups or Interviews	
Date of Birth	
Postcode	

Name of child:

Registration group:

School:

Name of parent/carers:

Signature: Date:



Leadership - Child Information Sheet

We would like to invite you to take part in a research project aiming to improve health and wellbeing in West Lancashire girls. You have been chosen to take part in a leadership programme to promote physical activity and wellbeing among adolescent girls. You will be asked to attend a training day at Edge Hill University, which will be organised through your school in partnership with the PE department and which will take place during school hours. There will then be a further six weekly training sessions based at your school. As part of the project you will be asked to take part in the following activities:

- **Leadership training** – attend sessions on leadership, physical activity, health and wellbeing, motivation and goal setting.
- **Questionnaires** – Surveys will ask you about each session and your experiences as part of the project.
- **Focus groups & Interviews** - Questions will be asked about girls' thoughts on taking part in the leadership training programme and their thoughts on physical activity both in school and in after school clubs.
- **New after school club** – there will be a new afterschool activity club starting at your school which you will be asked to help develop as part of the leadership training programme. You will be asked to take part in these sessions with your friends if you want to, though this is not compulsory that you attend the sessions.

What do I need to do if I would like to take part in this study?

If you are happy to take part in the project you DO NOT NEED TO DO ANYTHING. You will be asked if you are happy to take part in **some** or **all** of the study again before it starts and you will be asked to sign a form to confirm this. You do not have to take part if you do not want to.



What do I need to do if I DO NOT want to take part in this study?

You do not have to take part. If you DO NOT want to take part in **any part** of the study, please fill out the 'child assent form' attached.





Leadership - Child Assent Sheet

You are being asked to take part in a research project which is about physical activity and health. If you have read the information sheet and are happy to take part in all the measurements all you need to do is fill out the **GREEN** box at the bottom of the page. If you **do not want to take part** in SOME or ALL of this research project, please tick the relevant boxes in the **RED** table below AND fill in the **GREEN** box at the bottom of the page.

	I DO NOT want to provide the following information/measurements: ✓
Leadership Training	
Questionnaires	
Focus Groups or Interviews	
Date of Birth	
Postcode	

Please circle 'Yes' if you agree, or 'No' if you do not agree to the following questions

Have you had read (or read yourself) the information sheet about this project and have you had opportunities to ask about anything you are unsure of?	Yes	No
Do you understand you can stop taking part at any time?	Yes	No
Are you happy to continue and take part in my project?	Yes	No

Child's Name: _____ Date: _____

Person obtaining consent: _____ Date: _____



Parent/Carer Information Sheet

We would like to invite your daughter to take part in a research project aiming to improve health and wellbeing in West Lancashire children. With the help of the project your daughter's school will try new ways to increase the girl's physical activity levels and we will evaluate how successful this has been by asking girls to take part in the following activities:

- **Physical activity monitoring** – A small activity monitor will be handed out and girl's will be asked to wear this for 7 consecutive days. It is worn on the wrist like a watch and should only be removed during water based activities like swimming/showering.
- **Questionnaires** – Surveys will ask about girls' physical activity enjoyment, health and wellbeing and social support.
- **Focus groups & Interviews** - Questions will be asked about girls' thoughts on taking part in physical activity both in school and in after school clubs.
- **Height, weight, waist circumference** – These measures will take place away from the rest of the group with a female researcher. No one but the researcher will see the results, they will not be made available to the school and will not be sent home.



All information about your daughter including their results will be treated with the strictest confidentiality. No identifiable information will ever be released by the project. All girls will be given a unique code which the research team will use instead of names. Data is securely stored and can be accessed by the research team only.

What do I need to do if I would like my daughter to take part in this study?

If you are happy for your daughter to take part in the measurements, you **DO NOT NEED TO DO ANYTHING**. All girls will be asked if they are happy to take part before the study starts and will be asked to sign a form to confirm this. Girls do not have to take part if they do not want to.



What do I need to do if I **DO NOT** want my daughter to take part in this study?

Your daughter does not have to take part. If you **DO NOT** want your child to take part in **some** or **all** of the measurements, please fill out the attached "*opt out form*" and return it to school (PE Department) as soon as possible. The project will start 09/01/17 but you can withdraw your child at any time, even after the project has started.



Thank you for taking the time to read this information. If you have any questions, please do not hesitate to get in touch. More detailed information about the project can be found at www.tinyurl.com/j522cg3

Contact Details of Researcher:
Michael Owen, Edge Hill University
Email: Michael.Owen@edgehill.ac.uk
Tel: 01695 657 344



Parent/Carer Opt Out Sheet

If you are happy for your daughter to take part in all the project, you do not need to do anything and do not need to send any forms back to school. You should only return and complete this form if you **DO NOT** want your daughter to participate in **some** or **all** aspects of the project.

Please tick the boxes below relating to any information or measures you do not want the research team to collect.

	I DO NOT want the following information/measures taken from my daughter: ✓
Activity monitor/watch worn for 7 consecutive days	
Questionnaires	
Focus Groups or Interviews	
Height	
Weight	
Waist Circumference	
Date of Birth	
Postcode	

Name of child:

Registration group:

School:

Name of parent/carers:

Signature: Date:



Child Information Sheet

We would like to invite you to take part in a research project aiming to improve health and wellbeing in West Lancashire girls. With the help of the project your school will try new ways to promote physical activity and we will evaluate how successful this has been by asking you to take part in the following activities:

- **Physical activity monitoring** – A small activity monitor will be handed out and you will be asked to wear this for 7 consecutive days. It is worn on the wrist like a watch and should only be removed during water based activities like swimming/showering.
- **Questionnaires** – Surveys will ask about your enjoyment levels, health and wellbeing and social support.
- **Focus groups & Interviews** - Questions will be asked about your thoughts on taking part in physical activity both in school and in after school clubs.
- **Height, weight, waist circumference** – These measures will take place away from the rest of the group with a female researcher. No one but the researcher will see the results, they will not be made available to the school and will not be sent home.



What do I need to do if I would like to take part in this study?

If you are happy to take part in the measurements you DO NOT NEED TO DO ANYTHING. You will be asked if you are happy to take part in **some** or **all** of the study again before it starts and you will be asked to sign a form to confirm this. You do not have to take part if you do not want to.



What do I need to do if I DO NOT want to take part in this study?

You do not have to take part. If you DO NOT want to take part in **any part** of the study, please fill out the 'child assent form' attached.





Child Assent Sheet

You are being asked to take part in a research project which is about physical activity and health. If you have read the information sheet and are happy to take part in all the measurements all you need to do is fill out the **GREEN** box at the bottom of the page. If you **do not want to take part** in SOME or ALL of this research project, please tick the relevant boxes in the **RED** table below AND fill in the **GREEN** box at the bottom of the page.

	I DO NOT want to provide the following information/measurements: ✓
Activity monitor/watch worn for 7 consecutive days	
Questionnaires	
Focus Groups or Interviews	
Height	
Weight	
Waist Circumference	
Date of Birth	
Postcode	

Please circle 'Yes' if you agree, or 'No' if you do not agree to the following questions

Have you had read (or read yourself) the information sheet about this project and have you had opportunities to ask about anything you are unsure of?	Yes	No
Do you understand you can stop taking part at any time?	Yes	No
Are you happy to continue and take part in my project?	Yes	No

Child's Name: _____ Date: _____

Person obtaining consent: _____ Date: _____



Teacher - Information Sheet & Consent Form

We would like to invite you to take part in a research project aiming to improve health and wellbeing in West Lancashire children. With the help of your school we have been trying to develop new ways to increase the girls' physical activity levels and we want to evaluate how successful this has been by asking you some questions, either in a focus group with 4-6 other teachers or in a one-to-one interview. The questions will centre around how the project has been implemented in your school, the impact you feel the project has had on Y9 girls, your perspective on the feasibility of the project within the school setting and your general feedback on the project as a whole.

All information you give will be treated with the strictest confidentiality. No identifiable information will ever be released by the project. All participants will be given a unique code which the research team will use instead of names. Data is securely stored and can be accessed by the research team only.

If you **agree to participate** in these focus groups and interviews, please **tick** the boxes if you agree with the statement and **sign** below:

1. You have read and fully understand the information sheet and have had opportunities to ask about anything I am unsure of.	<input checked="" type="checkbox"/>
2. You understand that you can refuse to participate at any time without explanation and you do not have to answer any questions you do not want to.	<input type="checkbox"/>
3. You understand you will be audio (voice) recorded as part of the focus groups and interviews.	<input type="checkbox"/>
4. You understand your name will not appear in any published work.	<input type="checkbox"/>
5. Only written anonymous quotes of yourself will be used in published work.	<input type="checkbox"/>

I agree to participating in this project;

Name (Print): Date:

Sign: Date:

Person Obtaining Consent (Researcher):

Thank you for taking the time to read this information. If you have any questions, please do not hesitate to get in touch. More detailed information about the project can be found www.tinyurl.com/j522cg3

Contact Details of Researcher:

Michael Owen, Edge Hill University

Email: Michael.Owen@edgehill.ac.uk

Tel: 01695 657 344

Appendix 4: Educational leadership sessions theory map and session aims.

Session Focus	Session Overview / LO's	Behaviour Change Techniques	SCT / SDT Constructs
Workshop Day Part 1; Introduction to programme and leadership Information	<ul style="list-style-type: none"> - What is the purpose of the project? - Provide information about leadership and the role of peer leaders - What do the students think about leadership? - What are the traits of good leaders? 	<ul style="list-style-type: none"> - Participation in *fun* workshop activities - Prompt identification as role model/ position advocate - General communication skills training 	<ul style="list-style-type: none"> - Autonomy - Competence - Relatedness - Intrinsic Motivation - Role modelling - Self-efficacy
Workshop Day Part 2; PA and health knowledge	<ul style="list-style-type: none"> - What is PA? - What are the different type of PA? - What physical activities do the students do? - Importance of PA for good health, physical, psychological and social - Communication task 	<ul style="list-style-type: none"> - Provide information on consequences of behaviour in general - Provide information on consequences of behaviour to the individual - Provide normative information about others' behaviour - Prompt identification as role model/ position advocate 	<ul style="list-style-type: none"> - Autonomy - Competence - Outcome expectations - Outcome expectations - Outcome expectations - Role modelling
School Workshop 1; Motivation	<ul style="list-style-type: none"> - What is motivation? - How to motivate others? - Review of first PA session 	<ul style="list-style-type: none"> - Plan social support/ social change 	<ul style="list-style-type: none"> - Autonomy - Competence - Social support

		<ul style="list-style-type: none"> - Barrier identification/Problem solving 	
School Workshop 2; Goal setting	<ul style="list-style-type: none"> - What is goal setting? - How to set effective goals? - Develop goal setting skills / set targets to achieve 	<ul style="list-style-type: none"> - Goal setting (behaviour) - Prompt self-monitoring of behaviour including; setting goals, reviewing goals, specifying action plans and feedback on performance 	<ul style="list-style-type: none"> - Autonomy - Competence - Social support - Self-regulation
School Workshop 3; Barriers to PA and methods to increase PA	<ul style="list-style-type: none"> - Identify barriers to PA - Methods to break down barriers - More in-depth benefits of physical activity - Problem solving task 	<ul style="list-style-type: none"> - Barrier identification/Problem solving - Provide information on where and when to perform the behaviour (Prompts cues) 	<ul style="list-style-type: none"> - Self-efficacy - Autonomy - Competence - Intrinsic Motivation
School Workshop 4; Social support and review of programme	<ul style="list-style-type: none"> - How to provide social support to friends - How to encourage friends - How to engage with peers - Review previously covered content for information booklet - Problem solving task 	<ul style="list-style-type: none"> - Plan social support/ social change - Barrier identification/Problem solving 	<ul style="list-style-type: none"> - Social support - Self-efficacy - Autonomy - Competence - Relatedness
School Support Sessions 5 and 6;	<ul style="list-style-type: none"> - Revisit previously set goals - Re-set goals for future weeks 	<ul style="list-style-type: none"> - Review behaviour goals (goal setting) 	<ul style="list-style-type: none"> - Autonomy - Competence - Relatedness

Leadership support and mentoring	<ul style="list-style-type: none"> - Provide the leaders support and advice on their role - Discuss the new after school PA club and probe for feedback on the club - Encourage peer leaders in their role 	<ul style="list-style-type: none"> - Prompt self-monitoring of behaviour - Prompt review of behavioural goals - Barrier identification/Problem solving - Provide information on where and when to perform the behaviour (Prompts cues) 	<ul style="list-style-type: none"> - Intrinsic Motivation - Social support - Self-regulation - Self-efficacy
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Appendix 5. Peers focus group plan.

Opening

Ask girls to be totally honest – don't worry about what they say, nobody is going to get in trouble and the teachers won't hear about what you say. We just want you to help us make the project better next time.

Ask the girls if one person at a time could talk so the voice recorder can pick up the voices. Nobody's names will be associated with the comments it will all be anonymous.

So you might have noticed some of your friends or classmates have been attending leadership training over the last 2 months.

Main Questions

Did you know which girls in your year were physical activity leaders?

- How did you know this?

Did you speak to any of your physical activity leaders?

- What did you speak to them about?
- Did they give you any information about physical activity?
- Did you speak to them about the new after school club?

Did you receive any handouts from them?

If so what were the handouts about?

- After school club?
- PA information?

Have you learnt anything about physical activity from your friends / classmates in the last 2 months?

- What have you learnt?
- Have you learnt anything about the benefits of doing regular PA?
- Have you learnt anything about the consequences of not doing regular PA?

Do you prefer getting information from your friends / classmates compared to receiving information from teachers?

- If so why?

Do you feel as if you have done more activity over the last 2 months?

- If so why?

How did it make you feel to be part of the project?

Prompts

If a new student joined the school tomorrow, how would you describe the project to them?

If you were going to describe your experiences of the project to a friend, what would you say?

Afterschool Club Sessions

Did you see the club advertised around school?

How did you feel about the type of activity chosen for the after school sessions?

Did you attend the new after school club in your school?

If you didn't attend the club, why did you not come? Don't worry you are not going to get into trouble we just want to try and find out some of the reasons so we can design better programmes in the future that girls of your age group might prefer.

What type of afterschool activity club would you prefer and why?

If you did attend the afterschool club, how did you find the sessions?

- What did you enjoy?
- What did you not enjoy?

Data Collection Questions

How did you find the sessions were the activity team from Edge Hill came into your school and did the measurement sessions?

How did you find it wearing the activity watches?

Did you enjoy wearing the monitors for 7 days?

Were there any problems wearing the monitors?

How did you find the data collection day (questionnaires, height weight, waist)?

Useful Prompts

- Think back to last weekend...
- You mentioned... Would you expand upon that?
- Would you give me an example of that?
- What do you normally do?
- Tell a story...
- What does fit and healthy mean? What does it mean to them?
- What do your friends do?

Appendix 6. Leaders focus group plan.

Opening

Ask girls to be totally honest – don't worry about what they say, nobody is going to get in trouble and the teachers won't hear about what you say. We just want you to help us make the project better next time.

Ask the girls if one person at a time could talk so the voice recorder can pick up the voices. Nobody's names will be associated with the comments it will all be anonymous.

Main Questions

How did you find your role as a physical activity leader?

Going back to the start of the programme, how did you find the first session as Edge Hill University?

- What did you like / dislike about it?

After the first session did you understand what your role was as a Year 9 physical activity leader?

- What was the main job roles as a PA leader?

How did you find the sessions that were based at your school?

- How did you find the content of the sessions?
- How did you find the time and location of the sessions?

Did you understand the information about physical activity?

Have you learnt anything about physical activity as part of this project?

- What are the benefits of doing PA?
- What are the consequences of not doing enough or limited amounts of PA?

How did you get on with the mentors who took your sessions?

Has the programme improved your leadership skills?

- Have you enjoyed the programme?

Friends

How did you friends / classmates respond to the information you were passing out?

- What did you speak to them about?
- Did you give out any information about physical activity?
- How did they feel about these messages?

Did you speak to them about the new after school club?

- How did they feel about the new afterschool club?

Did you enjoy giving information to your friends / classmates compared to the teachers giving out the information?

- Do you think your friends listen to their other friends more?

How could we have supported you more in your role as PA leaders?

How do you feel about the project overall?

Prompts

If a new student joined the school tomorrow, how would you describe the leadership training project to them?

If you were going to describe your experiences of the leadership training project to a friend, what would you say?

Afterschool Club Sessions

How did you find it advertising the after school club?

Did you attend the new after school club in your school?

- How did you feel about the type of activity chosen for the after school sessions?

If you didn't attend the club, why did you not come? Don't worry you are not going to get into trouble we just want to try and find out some of the reasons so we can design better programmes in the future that girls of your age group might prefer.

What type of afterschool activity club would you prefer and why?

If you did attend the afterschool club, how did you find the sessions?

- What did you like / dislike about the sessions?

How did the sessions make you feel?

Data Collection Questions

How did you find the sessions were the activity team from Edge Hill came into your school and did the measurement sessions?

How did you find it wearing the activity watches?

- Did you enjoy wearing the monitors for 7 days?
- Were there any problems wearing the monitors?

Useful Prompts

- Think back to last weekend...
- You mentioned... Would you expand upon that?
- Would you give me an example of that?

- What do you normally do?
- Tell a story...
- What does fit and healthy mean? What does it mean to them?
- What do your friends do?

Appendix 7. Mentors focus group plan.

Start of placement

- Why did you choose a research placement and what did you expect from placement?

How were the initial weeks of placement? (Pre-Christmas)

- What tasks did you have to do?
- How did you think the placement was going to go?

How did you find the training sessions?

- Height weight waist
- Accelerometer
- Questionnaires
- Focus groups

Data collection

How did you find the data collection sessions?

- What were your roles?
- How did you find interacting with the girls as part of the data collection team?
- Did you feel prepared enough to be doing the roles you were initially doing?

How did you find your individual role?

During the second data collection period (follow ups), how was it taking the focus groups?

- Did you encounter any problems?
- Did you change your tactics as your experience grew? If so how?

Workshops

As the project got started properly after Christmas, did you understand the purpose of the project and were you confident in your role?

Leadership Day

How did you find the first leadership day at EHU?

- Were you prepared enough to deliver the session?
- How did you find the content?
- How was your first interactions with the students?
- How was it working in a team of 6?

Looking back was there anything you would have done differently with the girls on the leadership day @EHU?

- Content?
- Delivery?
- Interactions?

Leadership workshops delivered in the schools

How did you feel delivering these sessions in the schools compared to EHU?

How were the girls in these sessions?

- (try to get to some of the reasons behind engagement of leaders)

Where there any barriers in delivering complete leadership sessions?

- How did you adapt?

How was your interaction with the teachers around these sessions? (Name schools).

- Could this be improved in anyway?

How did these sessions develop over the 6 weeks?

- Content
- Delivery style

How did you support the girls in their role as PA leaders within their schools?

How did you see your role within these sessions? (Where you a teacher, leader or mentor?)

- Why do you feel this?
- Why do you relate to this particular role?

What is a mentor?

Do you think you could have done anything differently to be a mentor to the girls?

Could the session plans have helped with this?

Could you interact with the girls differently?

Could the girls relate to you as university students?

- If not, why not?

Do you think the peer mentoring was successful in the schools you worked in? (There is no right or wrong answer)

- Please explain your answer?

Do you think this method involving 3rd year PESS students as mentors is feasible and acceptable for your own peers next year and the girls in the schools?

What were the main differences between the two schools you delivered the leadership sessions to?

- Leaders
- School
- Facilities
- Engagement
- Behaviour

Overall, how could these sessions be improved moving forward?

Based on your experiences in the school, what could have been done differently by the schools to improve the LEADERSHIP sessions?

After School Clubs

How did you feel delivering these after school clubs?

What problems did you encounter?

What was the influence of the teachers on these sessions?

Did you think it was an effective model having the leadership and after school club within the same school?

Based on your experiences in the school, what could have been done differently by the schools to improve the after-school club?

Through being part of this project do you feel it has influenced your own PA selections?

- If so why?

Interactions with researcher

How did you find the researcher at the start and how has that developed over the placement period?

How did you find the training sessions provided?

How did you find the emails from the researcher regarding the session?

- Was this the most effective means of communication?
- Did they provide you with all the information you needed?
- When did you receive your content for the next week and was this enough time to prepare?
- How long did it take for you to prepare the workshop sessions?

What else could have been done to pass you the information?

How did you find the overall support provided by the researcher during your placement?

Compared to your other friends' placement do you feel that you made a good/bad selection in choosing a school based research placement?

Finally

What have you got from the placement?

What can you take away from the placement into the future?

Any other comments or feedback you would like to say about the project overall? Have a think.....

Or anything you would like to add about a topic we have already covered?

Thank you.

Appendix 8. Teacher interview plan.

Opening

We just want you to help us make the project better next time. If one person at a time could talk so the voice recorder can pick up the voices. Nobody's names will be associated with the comments it will all be anonymous.

Main Questions

Overall, what is your perspective on how the physical activity / leadership project was implemented within your school over the last 2 months?

How do you think the leaders responded to the project?

Do you think the concept of leaders passing information to their friends regarding PA worked?

- How did the non-leaders year 9 girls respond to the project?
- How did the non-leaders year 9 girls respond to the information the leaders were passing out?

Going back to the start of the programme,

- Do you think the right leaders were chosen?
- What could we as a research team have done differently to help you make those decisions?

How did you find the first session as Edge Hill University?

- Do you think that the leaders fully understood their roles and responsibilities?
- Did the girls interact with the EHU students as you expected?
- Did it help having all girls?

How were the sessions based at your school?

- How were these for you as a teacher?
- Time and location of session appropriate?
- How could we improve these sessions?

Do you feel think your Year 9 girls have learnt more information about physical activity?

- Leaders?
- Peers?

Do you think that your year 9 girls are more engaged with physical activity now?

Afterschool Club Sessions

How did the girls respond to the new after school club?

How did you feel about the type of activity chosen for the after-school sessions?

Why do you think that more students did not engage in the after-school club?

Did it work having the afterschool club run parallel to the leadership sessions or should they have followed each other?

Personal Job Related

How was the project from your perspective as a teacher?

- What went well
- What could have been done differently?

How much extra work was it for you personally to be involved in organising the project?

- Set up meetings
- Data collection dates
- Watches – collection, problems, return
- Emails – what is the best form of communication for teachers
- Was your role as a teacher affected by being involved with the project?

Was it feasible to help support the project around your current role or was there too much burden on the teachers?

Data Collection Questions

- How did you find the sessions were the activity team from Edge Hill came into your school and did the measurement sessions?
- How was it for you inside the school trying to get the monitors back?

Moving Forward

What can we learn from this experience to improve?

Can we as a research team do anything differently to help ease the load on you?

If you were to do a project similar to this in your school again, what things would you do differently / what would you keep the same?

Overall, how do you think the project could be improved?

How can we get girls more active, what programmes would you like to see more of in the future that from your experience you think would be beneficial of adolescent girls?

Anything you would like to add to feedback to the project team what we haven't covered?



Review Article

The effectiveness of school-based physical activity interventions for adolescent girls: A systematic review and meta-analysis



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ABSTRACT

Physical activity (PA) decreases during the transition from childhood to adolescence, with larger declines observed in girls. School-based interventions are considered the most promising approach for increasing adolescents' PA levels although, it is unclear which types of school-based interventions have the greatest impact. The objective of this systematic review is to assess the impact and design of school-based PA interventions targeting adolescent girls. A systematic search was conducted using four electronic databases (PubMed, Web of Science, SPORTDiscus and PsychInfo). This systematic review was registered with PROSPERO (Registration number: CRD42016037428) and PRISMA guidelines (2009) were followed throughout. Twenty studies were identified as meeting the inclusion criteria and were included in a narrative synthesis. Seventeen studies were eligible for inclusion in a meta-analysis. There was a significant small positive treatment effect for school-based PA interventions for adolescent girls ($k = 17$, $g = 0.37$, $p < 0.05$). After an outlier was removed (residual $z = 7.61$) the average treatment effect was significantly reduced, indicating a very small positive effect ($k = 16$, $g = 0.07$, $p = 0.05$). Subgroup analysis revealed very small significant effects for multi-component interventions ($k = 7$, $g = 0.09$, $p < 0.05$), interventions underpinned by theory ($k = 12$, $g = 0.07$, $p < 0.05$), and studies with a higher risk of bias ($k = 13$, $g = 0.09$, $p < 0.05$). Intervention effects were very small which indicates that changing PA behaviors in adolescent girls through school-based interventions is challenging. Multi-component interventions and interventions underpinned by theory may be the most effective approaches to positively change adolescent girls' PA.

1. Introduction

The World Health Organisation (2014) has classified physical inactivity as the fourth leading risk factor for global mortality from non-communicable diseases. Insufficient physical activity (PA) contributes towards 3.2 million deaths (5.5%) worldwide per year (World Health Organisation, 2014). A strong body of evidence indicates that regular moderate-to-vigorous physical activity (MVPA) is associated with numerous health benefits for children and young people (Chief Medical Officers, 2011). These include reduced body fat and the promotion of healthy weight, enhanced cardio-metabolic and bone health, and enhanced psychological well-being (Biddle and Asare, 2011; Janssen and Leblanc, 2010).

Though the benefits and protective effects of regular PA are well understood, insufficient PA during adolescence is a major concern (Heitzler et al., 2011; Khunti et al., 2007; Sisson et al., 2010). Inactive

adolescents are more at risk of being overweight or obese and have a greater chance of developing type 2 diabetes (World Health Organisation, 2015). Additionally, physical inactivity is a major risk factor for not only poor physical health but is also associated with poor mental wellbeing (Ar-yuwat et al., 2013). More frequent engagement in PA contributes towards greater well-being and lower levels of anxiety and depressive symptoms in both sexes (McMahon et al., 2017).

According to global estimates of self-reported PA, 80% of 13–15-year-olds do not engage in 60 min of MVPA per day, with girls being less active than boys (Hallal et al., 2012). A combination of biological and psychosocial factors put adolescent girls at risk of inactivity and uptake of sedentary lifestyles (Young et al., 2014). A review of 26 longitudinal studies concluded that there was a 7% decrease in total PA per year during adolescence (Dumith et al., 2011), with the most recent studies indicating that girls' PA levels declined at a greater rate than boys'. Research assessing objectively measured PA from the

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International Children's Accelerometry Database (ICAD) suggests that boys were more active than girls but, both boys' and girls' MVPA levels declined steadily through adolescence (Cooper et al., 2015). There is no widely accepted explanation for this decrease in adolescent girls. However, it is suggested that alongside biological changes, lack of enjoyment, negative experiences in, and perceptions of school-based PA may be important factors (Barr-Anderson et al., 2008).

Previous systematic reviews (Camacho-Minano et al., 2011; Voskuil et al., 2017) and a meta-analysis (Pearson et al., 2015) have assessed interventions to promote PA in adolescent girls across school and community settings. Voskuil et al. (2017) reported highly variable effect sizes, inferring that PA interventions only had a small effect on objectively measured PA in girls aged 6–18 years (Voskuil et al., 2017). Camacho-Minano et al. (2011) found overall mixed results regarding the effectiveness of PA interventions for adolescent girls but, suggested that multicomponent school-based interventions, which included PE that addressed the unique needs of girls were the most effective. Pearson et al. (2015) reported small but significant effects ($g = 0.35$, $p < 0.001$) for the effectiveness of PA interventions on girls aged 12 to 18 years. Larger effects were found for interventions which were underpinned by theory, school-based, girls only, targeted younger adolescents (ages 12 to 15), multicomponent in design, and that targeted both PA and sedentary behaviour.

Camacho-Minano et al. (2011) and Pearson et al. (2015) suggested that school-based PA interventions are the most promising setting to impact adolescent girls' PA levels. Thus, this review aims to address this gap in the literature and assess the effectiveness of girl-specific and mixed-sex school-based interventions on adolescent girls' PA. The inclusion of mixed-sex studies is novel because often reviews (Camacho-Minano et al., 2011; Voskuil et al., 2017) focus only on interventions exclusively designed for girls, when mixed-sex interventions could be equally as effective for girls. The purpose of this study was to systematically review school-based PA interventions involving adolescent girls and quantify their effect through meta-analysis.

2. Methods

This systematic review was registered with PROSPERO (Registration number: CRD42016037428). This review adhered to the PRISMA reporting guidelines for systematic reviews (Moher et al., 2009).

2.1. Search procedure

A systematic search was conducted using four electronic databases (PubMed, Web of Science, SPORTDiscus and PsychInfo). Journal articles published in English post 31/12/2004 until the date of the last search (01/12/16) were considered for review. The key words included; physical activity, physical education, sedentary behaviour, sedentary time, walking, sport, fitness, energy expenditure, school, teacher, classroom, gymnasium, sports hall, recess, playtime, break time, playground, before-school and after-school. The search strategies are detailed in the supplementary information (Supplementary Table 1). Reference lists of retrieved articles were examined for additional articles.

2.2. Inclusion and exclusion criteria

Studies were eligible if they reported the effects of school-based PA interventions on PA outcomes among adolescent girls (mean age 11–18 years), with the primary outcome being objectively measured or self-reported PA levels. Feasibility and pilot studies were included. Mixed sexed studies were included if girls' data were presented separately to boys' or if girls' data were received upon request. A school-based intervention was defined as one that occurred in the school environment. The extended school day (8 am–6 pm) was used to

operationally define the school day, so as to capture school-based interventions that took place before and after formal hours (e.g., breakfast clubs, boot camps, and after-school activities). Studies could be randomised or non-randomised and only published peer-reviewed studies were reviewed. Only journal articles published post 31/12/2004 were considered after preliminary searches ('physical activity' AND 'girls' AND 'intervention') indicated that most interventions had been conducted in the last 10 years with the earliest published in 2004.

All search results were exported into a reference manager (Endnote $\times 7.4$, Thomson Reuters) and duplicates were removed. Initially, the first author (MO) screened all titles and abstracts for obvious irrelevance, and a random sample (20%) were also checked by another author (WC). The full-text of eligible studies were then retrieved and reviewed by two authors (MO and WC). Where full texts were not readily available, the lead author was contacted and asked to provide the full text for further assessment on eligibility. If no response was received after a follow-up reminder, these studies were excluded as they could not be fully assessed for eligibility. Any disagreements were resolved in a meeting involving three authors (MO, WC, and SF).

2.3. Data extraction and synthesis

Relevant data from the selected studies were extracted by the first author (MO) and checked by the second author (WC) (see Table 1). If studies reported multiple PA outcomes, data for the primary outcome stated in the studies' aims and objectives were used. Any disagreements were resolved through a consensus discussion between MO and WC. A narrative synthesis was completed to provide a summary of school-based PA interventions for adolescent girls (11–18).

2.4. Risk of bias assessment

Included studies were assessed for risk of bias using a modified tool (Morton et al., 2016; Pluye et al., 2009) appropriate for PA reviews which include measures for quantitative experimental and quantitative observational studies. This adapted risk of bias assessment tool (Supplementary Table 2) used a 1–4 scoring system (i.e., 1 = weak, 2 = moderate, 3 = strong and 4 = very strong) at study level as a combined risk of bias score. A higher risk of bias score indicates better methodological quality with a lower risk of bias score indicating poorer methodological quality. Risk of bias was scored on the presence or absence of each criteria respectively (sequence generation and/or randomisation, concealment and/or blinding, complete outcome data and/or low withdrawal/drop-out ($< 20\%$), appropriate outcome measure). Studies were scored on what was reported in the current article or if they cited a previously published protocol paper which was examined for further information.

2.5. Meta-analysis

Meta-analytic procedures were conducted in R (<https://cran.r->

Table 1
Data extraction procedure.

Study characteristics	(a) Author, year of publication, country (b) Aims and objectives of study (c) Participant characteristics (d) Study design (e) Intervention content
Theory underpinning intervention	(f) Any theory or model that the authors suggest underpins the intervention, including non-behaviour change theories
PA measurement tool	(g) Any measurement tool used to collect PA data, including outcome measure of PA
Primary PA findings	(h) Key findings of each study in relation to PA change due to the intervention

project.org) using the metafor package (Viechtbauer, 2010). Studies were included in the meta-analysis if they employed a pre-post control group design. Pre-post intervention PA levels were used as few studies included post-intervention follow up data. The meta-analyses effect size selected was Hedge's g , which provides a correction factor for smaller sample sizes ($k < 20$). Meta-analyses were conducted using random effects models to reflect the likelihood of different effect sizes underlying the studies due to the diversity of the included interventions and their implementation (Borenstein et al., 2010). Heterogeneity was assessed using Cochran's Q -statistic and I^2 (Higgins et al., 2003). The Q -statistic and corresponding p value provide a calculation of variance between study effects. A significant Q value indicates systematic differences between the individual studies which might influence the results. I^2 is represented as a percentage with a value of 0% indicating no dispersion and larger values indicating gradual increases in heterogeneity (i.e., 25% = low, 50% = moderate, 75% = high level of heterogeneity (Higgins et al., 2003). Subgroup analyses were performed on possible moderators of the average intervention effect. These were: physical activity measurement method (objective vs. self-report), intervention duration (short vs long), risk of bias (*/** vs. ***/****), intervention design (single component vs. multi-component), presence of underpinning theory (yes vs. no), and the target sex (girls only vs. mixed sex).

Outliers were identified to evaluate the influence of extreme values on the overall treatment effect. Studies with an inflated residual value approximately two standard deviations ($z = \pm 1.98$) above or below the average treatment effect were considered outliers. Publication bias was estimated by examining asymmetry of funnel plots (effect size vs. standard error) where asymmetry is indicative of publication bias (Sterne and Egger, 2001). Following these visual inspections, the trim and fill procedure (Duval and Tweedie, 2000a, 2000b), Orwin's fail safe number (Orwin, 1983) and Egger's regression test (Egger et al., 1997) were used to confirm the presence or absence of publication bias.

3. Results

3.1. Literature search

In total, 9383 records were identified. After screening and eligibility assessments, 20 records met the inclusion criteria for the narrative synthesis (Fig. 1).

3.2. Participant characteristics

Table 2 provides an overview of participant and study characteristics. In this review, the 20 studies evaluated a total sample of 10,755 girls across the interventions (Mean age = 12.88 years). Four studies reported mixed samples where girls' data were extracted (Bronikowski and Bronikowska, 2011; Haerens et al., 2006; How et al., 2013; Loucaides et al., 2009), with the remaining sixteen studies including girls only samples. The majority of studies were with girls aged 11–14 years, with only three studies (Dudley et al., 2010; Schofield et al., 2005; Taymoori et al., 2008) involving girls aged 15–17 years. Nine studies recruited girls only with no set eligibility criteria stated (Bronikowski and Bronikowska, 2011; Dewar et al., 2014; Fairclough and Stratton, 2005; Haerens et al., 2006; How et al., 2013; Huberty et al., 2014; Jago et al., 2015; Jago et al., 2012; Loucaides et al., 2009; Martin and Fairclough, 2008; Pate et al., 2005). For the remaining eleven studies, four were mixed-sex interventions but reported boys' and girls' PA outcomes separately (Bronikowski and Bronikowska, 2011; Haerens et al., 2006; How et al., 2013; Loucaides et al., 2009). Two studies stated that girls had to be enrolled in two semesters of PE (Jones et al., 2008; Young et al., 2006), two targeted low active girls (Robbins et al., 2006; Schofield et al., 2005), one targeted girls with low PA enjoyment (Dudley et al., 2010), one targeted girls at the preparation stage of exercise behaviour change, and one targeted girls who did

not meet national recommendations for MVPA (Robbins et al., 2012). Seventeen studies contained participant numbers < 1000, with the smallest sample being 15 participants (Martin and Fairclough, 2008). Three studies contained > 1000 participants (Haerens et al., 2006; Pate et al., 2005; Webber et al., 2008), with the largest sample being 3502 participants (Webber et al., 2008).

3.3. Study characteristics

Eight studies were conducted in the USA (Huberty et al., 2014; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Robbins et al., 2012; Spruijt-Metz et al., 2008; Webber et al., 2008; Young et al., 2006), with four studies from the UK (Fairclough and Stratton, 2005; Jago et al., 2015; Jago et al., 2012; Martin and Fairclough, 2008), and four from Australia (Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Schofield et al., 2005). There were: fourteen randomised controlled trials (RCTs) (Bronikowski and Bronikowska, 2011; Dudley et al., 2010; Haerens et al., 2006; How et al., 2013; Jago et al., 2015; Jago et al., 2012; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Webber et al., 2008; Young et al., 2006) including three cluster RCTs (Dewar et al., 2014; Jago et al., 2015; Jago et al., 2012), and one pilot RCT (Dudley et al., 2010); five quasi-experimental studies (Fairclough and Stratton, 2005; Loucaides et al., 2009; Martin and Fairclough, 2008; Robbins et al., 2012; Schofield et al., 2005); and one case-crossover study (Huberty et al., 2014). Five studies had PA measurement periods of 12 to 36 months (Bronikowski and Bronikowska, 2011; Dewar et al., 2014; Haerens et al., 2006; Jones et al., 2008; Webber et al., 2008), including two which utilised a long-term follow-up (i.e., ≥ 12 months) after the cessation of the intervention (Bronikowski and Bronikowska, 2011; Dewar et al., 2014). Eight studies had PA measurement periods of 5 to 12 months (Huberty et al., 2014; Jago et al., 2015; Jago et al., 2012; Pate et al., 2005; Robbins et al., 2012; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Young et al., 2006), including four studies that incorporated short-term follow ups (i.e., ≤ 6 months post-end of intervention) (Huberty et al., 2014; Jago et al., 2015; Spruijt-Metz et al., 2008; Taymoori et al., 2008). Seven studies had measurement periods that were < 4 months and did not include follow-up measurements (Dudley et al., 2010; Fairclough and Stratton, 2005; How et al., 2013; Loucaides et al., 2009; Martin and Fairclough, 2008; Robbins et al., 2006; Schofield et al., 2005). Eight studies were published since 2010 (Bronikowski and Bronikowska, 2011; Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Huberty et al., 2014; Jago et al., 2015; Jago et al., 2012; Robbins et al., 2012).

3.4. Intervention characteristics

Ten studies reported multi-component interventions (Dewar et al., 2014; Haerens et al., 2006; Huberty et al., 2014; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Robbins et al., 2012; Taymoori et al., 2008; Webber et al., 2008; Young et al., 2006). Components included school environment adaptations, modified PE lessons, extra-curricular PA sessions, educational sessions, counselling sessions, and provision of further opportunities to be physically active (e.g., lunch and break time PA clubs). Ten studies reported single-component interventions. Four of these were modified PE lessons (Bronikowski and Bronikowska, 2011; Dudley et al., 2010; Fairclough and Stratton, 2005; How et al., 2013; Martin and Fairclough, 2008), three were after-school dance interventions (Jago et al., 2015; Jago et al., 2012), two were educational-based interventions (Schofield et al., 2005; Spruijt-Metz et al., 2008) and one was a modified playground intervention (Loucaides et al., 2009). Eighteen of the interventions provided an opportunity for the participants to engage in PA, such as modified active PE lessons, lunchtime PA sessions and after-school PA clubs. Twelve of the interventions incorporated an educational component. Ten interventions lasted for < 4 months in total duration (Dudley et al., 2010; Fairclough and

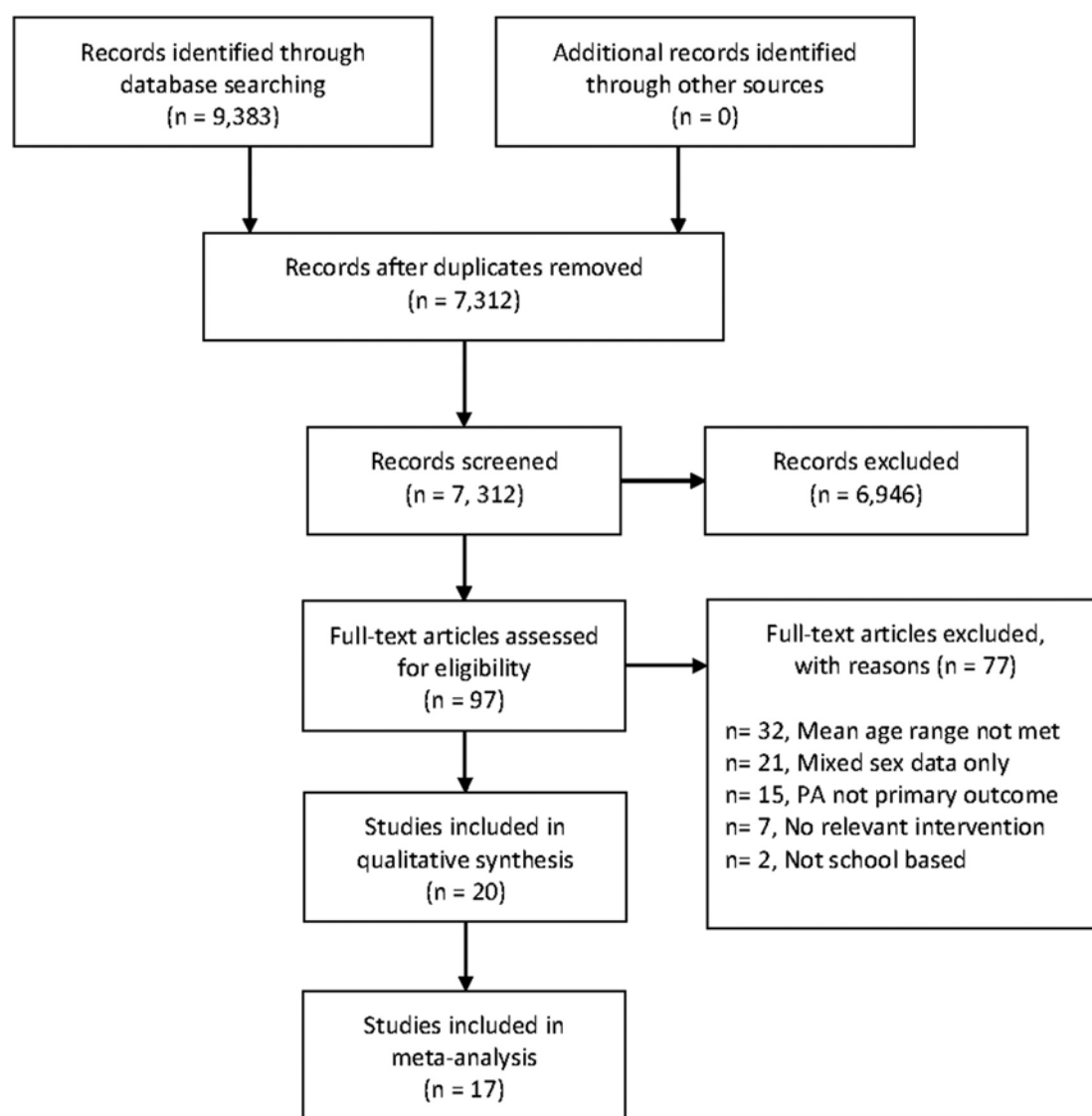


Fig. 1. PRISMA flow diagram (Moher et al., 2009) to show each stage of the systematic eligibility process.

Stratton, 2005; How et al., 2013; Huberty et al., 2014; Jago et al., 2015; Loucaides et al., 2009; Martin and Fairclough, 2008; Robbins et al., 2006; Schofield et al., 2005; Spruijt-Metz et al., 2008), with the shortest intervention period being reported as 5–7 days (Spruijt-Metz et al., 2008). Five interventions lasted 6–10 months (Jago et al., 2012; Pate et al., 2005; Robbins et al., 2012; Taymoori et al., 2008; Young et al., 2006), and five lasted for 12–36 months (Bronikowski and Bronikowska, 2011; Dewar et al., 2014; Haerens et al., 2006; Jones et al., 2008; Webber et al., 2008).

3.5. Intervention delivery

Thirteen of the interventions were delivered by school staff including PE teachers (Bronikowski and Bronikowska, 2011; Dewar et al., 2014; Dudley et al., 2010; Fairclough and Stratton, 2005; Haerens et al., 2006; How et al., 2013; Huberty et al., 2014; Jones et al., 2008; Martin and Fairclough, 2008; Pate et al., 2005; Spruijt-Metz et al., 2008; Webber et al., 2008; Young et al., 2006). Two were delivered by dance instructors (Jago et al., 2015; Jago et al., 2012), who taught dance-specific sessions. Two were delivered by a research team (Schofield et al., 2005; Taymoori et al., 2008), one was delivered by the school nurse and physical activity club instructors (Robbins et al., 2012), and one was delivered through a combination of an online advice

programme, a paediatric nurse and a phone-based research assistant (Robbins et al., 2006). One intervention was a playground modification which had no direct deliverer (Loucaides et al., 2009).

3.6. Outcome measures

Five methods were used to measure PA (Table 2). PA was objectively measured with accelerometers in ten studies (Dewar et al., 2014; Dudley et al., 2010; Haerens et al., 2006; How et al., 2013; Huberty et al., 2014; Jago et al., 2015; Jago et al., 2012; Martin and Fairclough, 2008; Robbins et al., 2012; Webber et al., 2008), and subjectively measured through self-report questionnaires in nine studies (Bronikowski and Bronikowska, 2011; Dewar et al., 2014; Haerens et al., 2006; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Young et al., 2006). Two studies combined self-report and accelerometers (Dewar et al., 2014; Haerens et al., 2006), one study used pedometers (Loucaides et al., 2009), one study combined pedometers and self-reported PA (Schofield et al., 2005), and one study used heart rate (HR) and direct observation (Fairclough and Stratton, 2005). Seven out of eight studies published from 2010 onwards utilised accelerometers (Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Huberty et al., 2014; Jago et al., 2015; Jago et al., 2012; Robbins et al., 2012). Eight out of twelve

Table 2
Study characteristics, and key findings from each intervention.

Study	Design & country	Underpinning theory	Participants	Intervention duration & measurement period	PA measurement method & PA outcome measure	Key findings
1. Bronikowski and Bronikowska (2011)	RCT, Poland	Hellison's model of teaching responsibility through PA	n = 170; mean age = 13.22 (0.3) Mixed sex study	15-Month intervention & 30-month study from baseline post-intervention (month 15 to follow-up (month 30).	Self-report & frequency of weekly leisure-time PA	Significantly increased trends in the frequency of undertaking leisure time PA in INT groups for girls ($p < 0.01$), differences sustained in the 15-month follow-up after cessation of the intervention.
2. Dewar et al. (2014)	Cluster RCT, Australia	Social cognitive theory	n = 357; mean age = 13.2 (0.5) Girls only study	12-month intervention & 24-month study from baseline to post-intervention (12 months) and follow-up (month 24).	Accelerometry and self-report & % of MVPA per valid day	No observed improvements for PA levels. Self-report data shows girls in the INT group had a significantly greater reduction in sedentary activities (-56.4 min/day; $p < 0.05$).
3. Dudley et al. (2010)	Pilot RCT, Australia	Social cognitive theory	n = 38; mean age = 16.5 (0.2) Girls with low levels of PA enjoyment only	11-week intervention & 3 month study from baseline to post-intervention.	Accelerometry & Accelerometry counts	There was a non-significant smaller decline in participation in PA during school sport for INT group compared to CON group.
4. Fairclough and Stratton (2005)	Quasi-experimental design, England	None specified	n = 26; mean age = 12.4 (0.4) Girls only study	5-week intervention & 6-week study from baseline to post-intervention.	Direct observation and HR monitor & % of lesson time in MVPA	INT group engaged in significantly more MVPA in PE lesson than those in the CON lesson (18.5% vs 13.5%; $p < 0.05$). INT group engaged in MVPA for an average of 11.9% more lesson time than the CON group.
5. Haerens et al. (2006)	RCT, Belgium	The theory of planned behaviour and the trans-theoretical model	n = 1039; mean age = 13.1 (0.8) Mixed sex study	24-Month intervention & 24-month study from baseline to 12 and 24 post-baseline.	Accelerometry and self-report & minutes of total PA per day	Time spent in PA of light intensity decreased significantly less for girls in the INT groups (-2 min/day) compared with the CON group (-20 min/day, $p < 0.05$) at 2 years post-baseline.
6. How et al. (2013)	RCT, Australia	Self-determination theory	n = 125; age = year 8 (13–14 years) Mixed sex study	15-week intervention & 15-week study from pre-intervention to post-intervention	Accelerometry & % of lesson time in MVPA	Girls who chose option 3 INT group (24.5%; design own lessons based on advice/guidelines) were significantly (both $p < 0.01$) more physically active for a greater percentage of time than CON (19.1%; standard lesson) and option 2 INT group (16.5%; 'PE development officer')
7. Huberty et al. (2014)	Case-crossover design, USA	None specified	n = 59; mean age = 11.3 (0.7) Girls only study	12-week intervention & 7/8 month study from baseline to mid-1, mid-2, post-intervention and 3 months follow-up.	Accelerometry & Total MVPA minutes per day	INT group was associated with a statistically significant ($p < 0.05$) increase in MVPA compared to CON group for girls aged 11–13 years = (1.5 min, 95CI 0.4 to 2.6)
8. Jago et al. (2012)	Cluster RCT, England	None specified	n = 203; Age = Year 7 (11–12 years) Girls only study	9-week intervention & 5-month study from baseline to time 1 (week 8 or 9) and time 2 (3 months follow-up).	Accelerometry & Weekday MVPA minutes	At time 1 there was a -6.8 difference in MVPA week day minutes for the INT group compare to the CON incentive group (95CI 18 to 4). At time 2 there was an 8.7 difference between INT group compared to CON incentive group (95CI 6 to 12). Wide confidence intervals suggest potential positive but not significant intervention effects.
9. Jago et al. (2015)	Cluster RCT, England	Self-determination theory	n = 571; Age = Year 7 (11–12 years) Girls only study	8-Month intervention & 12-month study from baseline to time 1 (17–20 weeks) and time 2 (52 weeks).	Accelerometry & Weekday MVPA minutes	No evidence that the after school dance programme had any significant effect on weekday MVPA levels, overall PA or PA during the afterschool period. However, during the afterschool period on dance

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Table 2 (continued)

Study	Design & country	Underpinning theory	Participants	Intervention duration & measurement period	PA measurement method & PA outcome measure	Key findings
10. Jones et al. (2008)	RCT, USA	Social cognitive theory and the trans-theoretical model	n = 718; mean age = 11.6 (0.4) Girls only study must be enrolled in 2 semesters of PE	18-month intervention & 18-month study from baseline to interim-intervention (month 6/7/8) to follow-up (month 18).	Self-report & total MVPA minutes per day	days versus non-dance days' girls obtained 15 min more LPA, 4.7 min more MVPA and 258 more accelerometer counts. INT group had higher means for overall total daily minutes of PA and daily MVPA minutes at follow-up compared to CON group. But, only total daily minutes of VPA were significantly higher at follow-up for INT (difference = 6 min, 95% CI = 5.82–6.18, p = 0.05) compared to CON. A 45.4% increase in VPA minutes from baseline for INT group (CON = 4.1% decrease).
11. Loucaides et al. (2009)	Quasi-experimental design, Cyprus	None specified	n = 114; mean age = 11.1 (0.3) Mixed sex study	4-week intervention & 5–6 week study from pre-intervention and 4 weeks post-intervention.	Pedometer & Step count	Small but non-significant increase in mean steps observed during 20-min break period in INT 2 school 852 (384) to 1004 (525) from baseline to post INT. compared to slight decreases in both CON 1055 (421) to 962 (466) and INT 1 school 1224 (403) to 1150(339).
12. Martin and Fairclough (2008)	Quasi-experimental design, England	None specified	n = 15; age = year 7 (11–12 years) Girls only study	4-week intervention & 8-week study from pre-intervention (1–4 weeks) to post-intervention (week 8).	Accelerometry & % of lesson time in MVPA	Girls engaged in MVPA pre-INT for 29.7% (16.6 min) of lesson time, which increased to 34.9% (19.3 min) during intervention lessons (p < 0.05).
13. Pate et al. (2005)	RCT, USA	Social cognitive theory	n = 2744; mean age = 13.6 (0.6) Girls only study	8–10 month intervention (1 school year) & 12-month study from baseline (spring 8th grade) to follow-up (spring 9th grade).	Self-report & 30-min blocks of MVPA per day	Increases observed in self-reported ≥ two 30 min blocks of MVPA per day for INT group from baseline to post INT 68.6% to 72.0% but, results were not significant. However, there were significant differences in the percentage of girls who reported regular VPA in the INT group compared to the CON group (44.5% vs 36.4%). A significant increase of 8% (p < 0.05).
14. Robbins et al. (2006)	RCT, USA	Pender's health promotion model and the trans-theoretical model	n = 77; Age = Grade 6–8 (11–14 years) Low active girls only study	12-week intervention & 12-week study from baseline (week 1) to post-intervention (week 12).	Self-report & minutes in MPA plus VPA	No differences in self-reported PA between the INT and CON groups. Both the INT group and CON group showed increases in minutes in MPA plus VPA across 2 weekdays and 2 weekend days but these were non-significant.
15. Robbins et al. (2012)	Quasi-experimental design, USA	Pender's health promotion model	n = 69; mean age = 11.44 (0.7) Girls < MVPA national recommendations only	6-month intervention & 6-month study from baseline to 6 months follow-up.	Accelerometry & Minutes of MVPA per hour	No statistically significant differences in PA levels for minutes of MVPA per hour for the INT or CON group. But, the differences were in the expected direction, with the INT group having slightly higher improvement in minutes of MVPA per hour (0.43) compared to CON group (0.07) from baseline to 6 months follow-up.
16. Schofield et al. (2005)	Quasi-experimental design, Australia	None specified	n = 85; mean age = 15.8 Low active girls only	12-week intervention & 12-week study from pre-intervention, mid-intervention (week 6) and post-intervention (week 12).	Pedometer and Self-Report & Step count	Pedometer INT group significantly increased their total PA (Avg mean daily steps increase of 2747), when compared

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Table 2 (continued)

Study	Design & country	Underpinning theory	Participants	Intervention duration & measurement period	PA measurement method & PA outcome measure	Key findings
17. Spruijt-Metz et al. (2008)	RCT, USA	Self-determination theory and the theory of meanings of behaviour	n = 459; mean age = 12.47 (0.6) Girls only study	5–7 day intervention & 6–7 month intervention from baseline (3 months prior to intervention) to follow up (3 months post-intervention).	Self-report & 30-min blocks of activity of various intensities	with the CON group ($p < 0.05$) at post-INT. No significant effects on PA of any intensity; VPA, MVPA MPA or LPA. However, the intervention had a significant effect on reducing time spent on SB ($p < 0.05$).
18. Taymoori et al. (2008)	RCT, Iran	Pender's health promotion model and trans-theoretical model	n = 161; mean age = 14.79 (0.4) Girls at preparation stage of exercise behaviour change only	6-month intervention & 12-month intervention from pre-intervention to post-intervention (month 6) to 6 month follow-up (month 12).	Self-report & minutes of total PA per day	TTM and HP group increased mean minutes of PA per day from 27.16 (12.02) at pre-INT to 75.80 (27.52) at post-INT with a slight drop to 60.04 (24.87) at follow-up (both $p < 0.05$) compared to CON group. This was similar for the solely HP group increasing from 28.56 (11.30) to 73.61 (28.73) at post-INT with a drop to 56.79 (27.58) at follow-up (both $p < 0.05$) compared to CON group.
19. Webber et al. (2008)	RCT, USA	Operant learning theory, social cognitive theory, organizational change theory and the diffusion of innovation model in a social-ecologic framework	n = 3504; age = grades 6–8 (11–14 years) Girls only study	36-month intervention & 36-month study from baseline to month 24 post-intervention (staff directed) to month 36 (program champion) post-intervention.	Accelerometry & Average daily minutes of MET-weighted minutes of MVPA	After the 2 years staff-directed INT, there were no differences (mean = -0.4 , 95% CI = -8.2 to 7.4) in adjusted MET-weighted minutes of MVPA between 8th-grade girls in schools assigned to INT or CON groups. However, significant differences were found between INT and CON groups after an additional year of program champion delivered intervention (INT group 10.9 min more MET-weighted MVPA, $p < 0.05$).
20. Young et al. (2006)	RCT, USA	Social action theory	n = 221; mean age = 13.8 (0.5) Girls only study must be enrolled in 2 semesters of PE	8-month intervention & 9-month study from baseline to follow-up (month 8 or 9).	Self-report & estimated total energy expenditure	INT classes spent 46.9% of PE class time in MVPA compared with 30.5% of the time for control classes ($p < 0.001$). However, while the INT was successful in increasing MVPA in PE class, no changes were observed in overall, daily, moderate, or hard to very hard mean energy expenditure in either the INT or the CON group.

Notes. CON = control, INT = intervention, PA = physical activity, SB = sedentary behaviour, MVPA = moderate to vigorous physical activity, VPA = vigorous physical activity, LPA = light physical activity, MPA = moderate physical activity, min = minutes, PE = physical education, TTM = trans-theoretical model, HP = health promotion, RCT = randomised control trial.

For mixed sex studies participant characteristics are shown for girls only.

studies published from 2005 to 2010 used self-reported measures of PA (Haerens et al., 2006; Jones et al., 2008; Pate et al., 2005; Robbins et al., 2006; Schofield et al., 2005; Spruijt-Metz et al., 2008; Taymoori et al., 2008; Young et al., 2006).

Thirteen different units of measurement were used to report a change in PA levels (Table 2). Studies reported percentage of lesson time in MVPA (Fairclough and Stratton, 2005; How et al., 2013; Martin and Fairclough, 2008), weekday MVPA minutes (Jago et al., 2015; Jago et al., 2012), total week MVPA minutes per day (Huberty et al., 2014; Jones et al., 2008), self-reported 30 min blocks of activity (Pate et al., 2005; Spruijt-Metz et al., 2008), minutes of total PA per day (Haerens et al., 2006; Taymoori et al., 2008), MVPA per hour (Robbins et al., 2012), total MVPA percentage per valid day (Dewar et al., 2014), average daily minutes of MET-weighted minutes of MVPA (Webber et al., 2008), minutes in MPA plus VPA (Robbins et al., 2006), estimated total energy expenditure (Young et al., 2006), accelerometer counts (Dudley et al., 2010), self-reported frequency of weekly leisure-time PA (Bronikowski and Bronikowska, 2011), and step counts (Loucaides et al., 2009; Schofield et al., 2005). As thirteen different units of measurement were used to assess PA, from this point onwards, changes in PA across groups of studies with different units of measurement, will be referred to as 'activity'.

3.7. Behaviour change theories

Thirteen studies explicitly reported that the interventions incorporated one or more behaviour change theories. These were Social Cognitive Theory (Dewar et al., 2014; Dudley et al., 2010; Jones et al., 2008; Pate et al., 2005; Webber et al., 2008), The Theory of Planned Behaviour (Haerens et al., 2006), Trans-theoretical Model (Haerens et al., 2006; Jones et al., 2008; Robbins et al., 2006; Taymoori et al., 2008), Self-Determination Theory (How et al., 2013; Jago et al., 2015; Spruijt-Metz et al., 2008), Pender's Health Promotion Model (Robbins et al., 2006; Robbins et al., 2012; Taymoori et al., 2008), Theory of Meanings Behaviour (Spruijt-Metz et al., 2008), and The Social Action Theory (Young et al., 2006). The largest study (Webber et al., 2008)

incorporated numerous theories within a Socio-ecologic Framework, including Operant Learning Theory, Social Cognitive Theory, Organisational Change Theory, and The Diffusion of Innovation Model. One study (Bronikowski and Bronikowska, 2011) used Hellison's Model of Teaching Responsibility through PA. Only five of the studies underpinned by behaviour change theory lasted 12 months or longer. The remaining six studies, which used relatively modest sample sizes ($n \leq 203$) did not specify the use of a behaviour change model or theory (Fairclough and Stratton, 2005; Huberty et al., 2014; Jago et al., 2012; Loucaides et al., 2009; Martin and Fairclough, 2008; Schofield et al., 2005).

3.8. Risk of Bias (Table 3)

Fifteen studies provided outcome data with < 20% dropout/withdrawal rates. Thirteen studies employed objective measures of PA, either for the complete sample size or for a sub-sample. Only seven of the included studies described the randomisation processes. Although eleven studies stated a randomisation procedure, the majority ($n = 10$) did not provide an explicit explanation of the randomisation process (Bronikowski and Bronikowska, 2011; Haerens et al., 2006; How et al., 2013; Loucaides et al., 2009; Martin and Fairclough, 2008; Pate et al., 2005; Robbins et al., 2012; Schofield et al., 2005; Spruijt-Metz et al., 2008; Webber et al., 2008; Young et al., 2006), which led to their poor randomisation scores. All studies scored weakly for allocation of concealment and/or blinding, with just two studies attempting to blind intervention staff (Jago et al., 2012; Webber et al., 2008). Only one study received a 'very strong' risk of bias score (Jago et al., 2012); three studies received a 'strong' risk of bias score (Fairclough and Stratton, 2005; Jago et al., 2015; Webber et al., 2008); ten studies received a 'moderate' risk of bias score (Dewar et al., 2014; Dudley et al., 2010; How et al., 2013; Huberty et al., 2014; Jones et al., 2008; Loucaides et al., 2009; Martin and Fairclough, 2008; Robbins et al., 2006; Robbins et al., 2012; Taymoori et al., 2008), six studies received a 'weak' risk of bias score (Bronikowski and Bronikowska, 2011; Haerens et al., 2006; Pate et al., 2005; Schofield et al., 2005; Spruijt-Metz et al., 2008; Young

Table 3
Risk of bias assessment.

Study	Appropriate sequence generation and/or randomisation	Allocation concealment and/or blinding	Complete outcome data and/or low withdrawal/drop-out	Appropriate outcome measure (PA)	Risk of bias score
1. Bronikowski and Bronikowska (2011)			X		*
2. Dewar et al. (2014)	X			X	**
3. Dudley et al. (2010)	X			X	**
4. Fairclough and Stratton (2005)	X		X	X	***
5. Haerens et al. (2006)				X	*
6. How et al. (2013)			X	X	**
7. Huberty et al. (2014)			X	X	**
8. Jago et al. (2012)	X		X	X	***
9. Jago et al. (2015)	X	X	X	X	****
10. Jones et al. (2008)	X		X		**
11. Loucaides et al. (2009)			X	X	**
12. Martin and Fairclough (2008)			X	X	**
13. Pate et al. (2005)			X		*
14. Robbins et al. (2006)	X		X		**
15. Robbins et al. (2012)			X	X	**
16. Schofield et al. (2005)				X	*
17. Spruijt-Metz et al. (2008)			X		*
18. Taymoori et al. (2008)	X		X		**
19. Webber et al. (2008)		X	X	X	***
20. Young et al. (2006)			X		*

* = Weak.
 ** = Moderate.
 *** = Strong.
 **** = Very strong.

Table 4
Sub-group analyses.

Subgroup variables	Effect size statistics				Null test	Heterogeneity statistics		Publication bias
	k	g	SE	95% CI		Z	Q	I ²
Pooled effect	17	0.37	0.19	0.0008, 0.73	1.96 [*]	80.12 ^{**}	94.91 %	2.05 [*]
Pooled effect ^a	16	0.07	0.04	−0.002, 0.14	1.92 [−]	23.98	0.01 %	2.07 [*]
Measurement method								
Objective	10	0.16	0.14	−0.11, 0.43	1.14	17.92 [*]	55.62 %	1.71
Self-report ^a	6	0.08	0.04	−0.002, 0.16	1.92 [−]	5.81	0.04 %	1.57
Study duration								
Short (< 6 months)	8	0.22	0.14	−0.06, 0.50	1.53	15.01 [*]	56.92 %	1.75
Long ^a (> 6 months)	8	0.06	0.04	−0.02, 0.14	1.51	8.84	0.00 %	0.76
Risk of bias								
* or ^{***}	13	0.09	0.04	0.02, 0.17	2.37 [*]	16.67	0.00 %	1.93 [−]
^{***} or ^{****}	3	0.01	0.23	−0.44, 0.46	0.05	4.99	65.95 %	1.30
Study design								
Single	9	0.02	0.06	−0.09, 0.14	0.41	11.83	0.00 %	2.13 [*]
Multi ^a	7	0.09	0.04	0.006, 0.18	2.09 [*]	11.30	0.02 %	1.47
Theory included								
Yes ^a	12	0.07	0.04	0.0009, 0.15	1.98 [*]	18.35	0.01 %	2.11 [*]
No	4	0.06	0.20	−0.33, 0.45	0.31	5.38	38.75 %	2.25 [*]
INT gender target								
Girls only ^a	13	0.06	0.04	−0.02, 0.13	1.53	19.35	0.03 %	1.61
Mixed	3	0.28	0.17	−0.05, 0.61	1.65	2.64	20.27 %	0.92

Note. k = number of effect sizes. g = effect size (Hedges' g). SE = standard error. 95% CI = confidence intervals (lower limit, upper limit). Z = test of null hypothesis. Q = test of variance between effects sizes. I² = total variance unexplained by moderator. Eggers' z = test of publication bias.

^a Outlier removed from subgroup.

[−] p equal to 0.05.

^{*} p < 0.05.

^{**} p < 0.001.

et al., 2006).

3.9. Meta-analysis

Of the 20 studies included in the narrative synthesis 17 provided sufficient data for inclusion in the meta-analysis. Huberty et al. (2014) was excluded for not reporting sample size, Martin and Fairclough (2008) did not use a control group and Webber et al. (2008) did not report variance of data. Cohen's (1988) effect size criteria were used to interpret the overall treatment effect for the main analysis and subgroup analyses. Of the 17 included studies, 12 reported a small effects ($g = -0.29$ to 0.26), four studies reported moderate to strong effects ($g = 0.65$ to 1.04) and one reported a very strong effect size ($g = 3.43$) (Taymoori et al., 2008). The meta-analysis revealed a significant small positive treatment effect ($k = 17$, $g = 0.37$, $p < 0.05$), for school-based PA interventions for adolescent girls (Table 4). Heterogeneity analysis indicated significant between-study variance ($Q = 80.12$, $p < 0.001$; $I^2 = 94.91\%$). The Taymoori et al. (2008) intervention was identified as an outlier due to large residual effects ($z = 7.61$). Once this study was removed the average treatment effect was significantly reduced by 0.30, indicating a very small positive effect which approached significance ($k = 16$, $g = 0.07$, $p = 0.05$) (Fig. 2). Heterogeneity was also substantially reduced when the outlier was removed ($Q = 23.98$, $p = 0.05$; $I^2 = 0.01\%$).

Inspection of the funnel plot for publication bias indicated asymmetry. The trim and fill procedure added 3 studies to the left side of the plot which reduced the overall treatment effect by 0.01. Orwin's fail-safe N calculation suggested that there would need to be 16 unpublished studies to reduce the treatment effect to a target effect size of $g = 0.11$, and Egger's regression test was significant ($z = 2.07$, $p < 0.05$). Collectively, these results indicated a high probability of publication bias.

Although heterogeneity from the pooled analysis was low, the individual effects from the included studies were extremely inconsistent, ranging from $g = -0.29$ to 1.04 . Thus, subgroup analyses were performed as planned to explore whether the identified subgroups

moderated the average intervention effect. The identified outlier study was removed from the relevant subgroups in all analyses. Significant effects were observed for studies with * or ** bias ratings ($k = 13$, $g = 0.09$, $p < 0.05$), for multi-component interventions ($k = 7$, $g = 0.09$, $p < 0.05$), and for interventions underpinned by theory ($k = 12$, $g = 0.07$, $p < 0.05$) but the magnitudes of these were small (Table 4). Subgroup analyses also revealed no effect for whether the interventions were targeted at girls only or mixed-sex, although only 3 mixed sex studies were included.

The three studies excluded from the meta-analysis all indicated positive results. Huberty et al. (2014) found that on the days the after school club was delivered the intervention group significantly increased MVPA by 1.5 min compared to the control group (non-afterschool club). Martin and Fairclough (2008) found that girls increased their percentage of lesson time MVPA by 5.2% (2.7 min) from non-intervention lessons to intervention lessons. Webber et al. (2008) found no significant differences after 2 years of the staff directed intervention. However, after a further year of program champion delivered intervention, girls had significantly more MET-weighted minutes of MVPA (10.9) compared to girls in the control school.

4. Discussion

This systematic review and meta-analysis examined the effect of school-based PA interventions on PA outcomes among adolescent girls. The meta-analysis results indicate that school-based PA interventions have only a very small effect on adolescent girls' PA levels. Some individual studies showed positive results and the subgroup analyses revealed promise for approaches underpinned by theory and multi-component interventions. Although school-based interventions have been suggested as being the most promising setting to intervene with adolescent girls (Camacho-Minano et al., 2011; Pearson et al., 2015), the observed small effect illustrates the difficulties and challenges of positively impacting adolescent girls' PA behaviors through the school setting. These difficulties may in part be due to a number of factors such as, social or cultural norms, ability to provide a wide range of PA

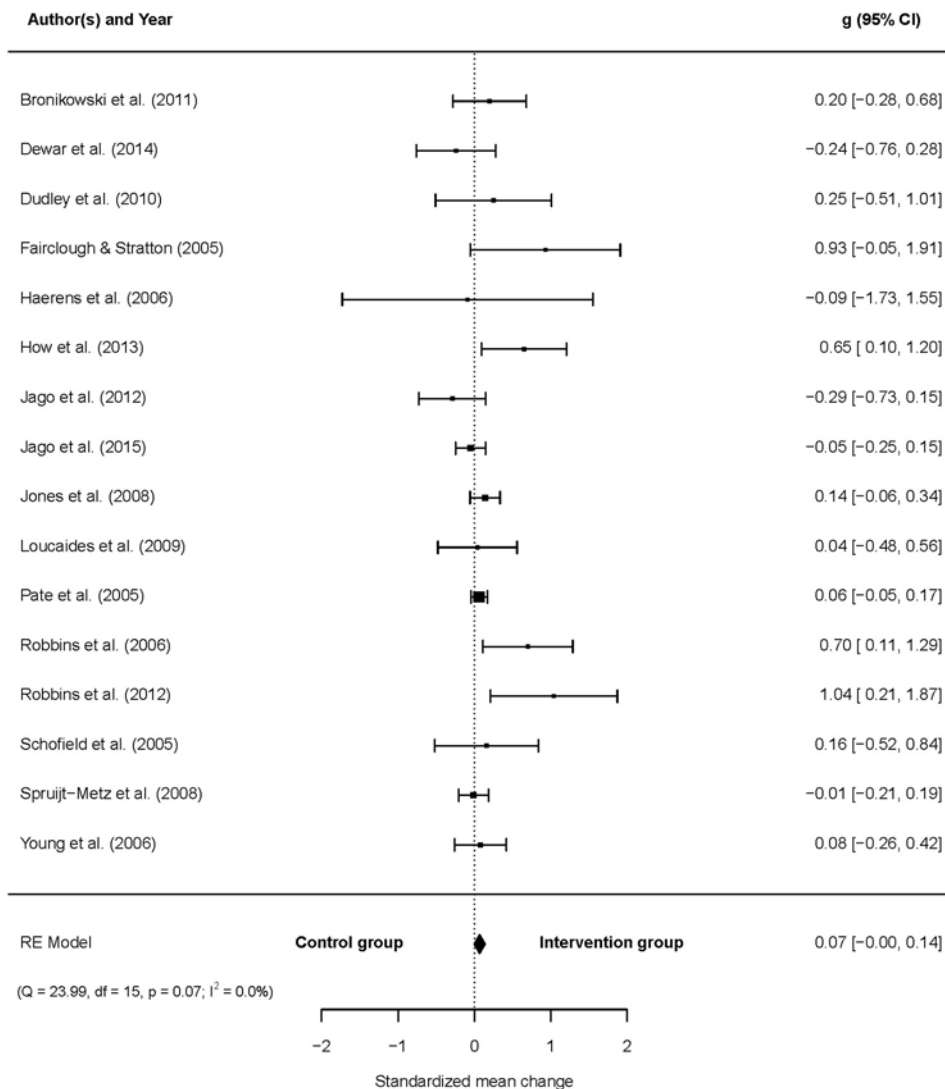


Fig. 2. Forest plot with outlier removed ($k = 16$). Graph depicts effect size and 95% CI for individual studies and the pooled estimate.

opportunities, short-term intervention periods, PA measurement methods, and small sample sizes which precluded the detection of significance.

Although subgroup analysis inferred a significant effect for interventions underpinned by behaviour change theory, this was a very small effect. This is consistent with findings from a recent review investigating the effectiveness of after-school PA interventions to increase MVPA (Mears and Jago, 2016). It was reported that a lack of convincing evidence exists that interventions underpinned by theory were more effective than those with no specified theory (Mears and Jago, 2016). The lack of a clear link between reported theoretical design and effectiveness could also be due to the implementation of the theories within the interventions. Few studies reported theoretical fidelity, which precludes direct inferences being made between intervention effectiveness and underpinning theory. To address this, future studies need to illustrate the direct links from theory to implementation as poor implementation of the theory could be contributing to the lack of success in some interventions (Naylor et al., 2015). The recently proposed Theory of Expanded, Extended, and Enhanced Opportunities (TEO) could provide a more practical and PA-specific theory to implement in school-based PA interventions, which is not clearly present in any of the reviewed interventions, and warrants further exploration (Beets et al., 2016). This theory can be used in conjunction with other more traditional behaviour change theories but helps provide a more PA-specific framework, to increase PA opportunities within the school setting.

Multi-component interventions were also found to have small significant effects. School-based multi-component interventions are well supported as effective approaches to impact adolescent PA levels (Kriemler et al., 2011; Pearson et al., 2015; Van Sluijs et al., 2007). Multicomponent intervention designs are consistent with the concept of Comprehensive School PA Programmes (CSPAPs), which are recommended as effective strategies to increase young people's PA (Centers for Disease Control and Prevention, 2013; World Health Organisation, 2010). CSPAPs are multicomponent in nature, aiming to intervene through PE, before and after school PA, during school PA, staff involvement, and family and community engagement. Using the CSPAP model as a form of comprehensive multicomponent intervention to target adolescent girls, integrated with an appropriate research design, may be a promising approach for future intervention efforts (Carson et al., 2014; McMullen et al., 2015).

Modified PE lessons were commonly used as single component interventions or as part of multicomponent interventions, and were effective in significantly increasing lesson time PA (Bronikowski and Bronikowska, 2011; Fairclough and Stratton, 2005; How et al., 2013; Martin and Fairclough, 2008). This supports previous research which has shown the impact of modified PE lessons designed to increase MVPA, with students engaging in 24% more MVPA during modified PE compared with students in usual PE practice conditions (Lonsdale et al., 2013). Similarly, Camacho-Minano et al. (2011) suggested that school-based interventions are more effective when enjoyment of PE is

prioritised and girls are given freedom of choice of activities. Enjoyment has been found to partially mediate the positive effect of modified PE interventions (Dishman et al., 2005), which further emphasises the importance of choice and enjoyment within school-based interventions for adolescent girls. This reinforces the importance of autonomy-supportive teaching principles such as, the Supportive, Active, Autonomous, Fair, Enjoyable (SAAFE) framework (Lubans et al., 2017). This evidence based framework encourages teachers to provide students with opportunities for autonomy during PA sessions to support the promotion of more activity during sessions (Lubans et al., 2017). However, PE occurs infrequently within schools (usually 1–2 h per week) and accounts for only a very small percentage of weekly waking hours, therefore its impact on total daily MVPA is limited.

The current review reveals a shift in the last seven years in school-based PA interventions for adolescent girls towards objective measurements of PA rather than subjective measures. Specifically, accelerometers were the preferred method of measurement, in 7 out of 8 studies conducted since 2010. The use of accelerometer-based measures allows for a more accurate assessment of PA intensity (Butte et al., 2012; Cain et al., 2013; De Vries et al., 2009). However, accelerometers provide no contextual information such as, who girls are doing activity with and what activity they are doing, which is valuable in social and fluid environments like schools. Moreover, issues such as waterproofing and wear site preclude adequate assessments of some movement modes such as, swimming or cycling (Dollman et al., 2009). Additionally, accelerometers have been found to have poor wear compliance in PA studies with adolescents (Borde et al., 2017). Few included studies utilised focus groups or interviews with participants post-intervention. Understanding the context for PA through these measurement methods may help researchers and practitioners to truly assess the effectiveness of interventions and refine and amend interventions.

Risk of bias scores did not appear to be associated with intervention effectiveness. Studies that scored poorly (* or **) for risk of bias showed a small significant effect in subgroup analyses. Risk of bias scores were low across the included interventions mainly due to the need for a greater explanation of the randomisation process which is consistent with a previous systematic review of adolescent girls (Camacho-Minano et al., 2011). Thus, poor scores may have been due to poor reporting rather than poor methodological design. Without a detailed explanation of the randomisation process, it could not be confirmed that the groups were truly distributed randomly (Higgins and Green, 2011). As found in previous reviews, both for PA interventions for adolescents (Camacho-Minano et al., 2011) and school-based behavioural interventions (Khambalia et al., 2012), allocation concealment and blinding were usually absent, and this negatively affected the risk of bias scores for the majority of included studies. The majority of studies showed low withdrawal and dropout rates (< 20%) which is positive considering the range of participant numbers and measurement methods reported. This could be due to the structure a school environment provides and the influence schools have on girls of this age (Kohl and Cook, 2013).

4.1. Strengths and limitations

To our knowledge, this is the first systematic review to combine girls-only and mixed-sex school-based PA interventions (2005 onwards) to assess their effectiveness for adolescent girls. Twenty one studies were excluded from the final synthesis because the authors did not respond to requests to provide PA data by gender within the 7-day timescale allowed. This limited response time is a limitation as this data potentially could have doubled the number of included studies, and interaction by sex tests were not explored for these studies. The inclusion of all study types, including feasibility and pilot studies, may have impacted the overall findings of the review as these tended to be smaller scale projects with small sample sizes. Where multiple primary PA outcomes were reported we used MVPA or MPA wherever possible to maintain relevance to PA guidelines. However, there were instances

where alternative PA outcomes were also included (e.g., steps, accelerometer counts).

4.2. Conclusion

The meta-analysis indicated a small but significant positive effect of school-based interventions on adolescent girls' PA. Sub-group analyses indicated small but significant effects for multicomponent interventions and interventions underpinned by theory. The recent trend towards the objective measurement of PA within the school setting with accelerometry data should continue. It is important that future research and policy makers continue to recognise the school environment as a vehicle for changing girls' PA levels with an emphasis on multicomponent interventions underpinned by theory.

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Conflicts of interest

None.

Transparency document

The Transparency document associated with this article can be found, in online version.

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Appendix A. Supplementary data

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Article

The Feasibility of a Novel School Peer-Led Mentoring Model to Improve the Physical Activity Levels and Sedentary Time of Adolescent Girls: The Girls Peer Activity (G-PACT) Project

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Abstract: Regular physical activity (PA) is associated with numerous physical and psychological health benefits. Adolescents, specifically girls, are at risk of physical inactivity. To date, there is limited research on PA interventions involving peers, which could encourage more adolescent girls to engage in PA. The investigation aimed to evaluate the feasibility of a novel school three-tier peer-led mentoring model designed to improve PA levels and reduce sedentary time (ST) of adolescent girls. Two-hundred and forty-nine Year 9 adolescent girls (13–15 years old) from three UK secondary schools were invited to participate in a peer-led mentoring intervention (Girls Peer Activity (G-PACT) project). The peer-led mentoring model was delivered in all three schools. Two of the schools received an additional after-school PA component. PA and ST were assessed through wrist-worn accelerometry. Girls who received an exercise class after-school component significantly increased their whole day moderate-to-vigorous PA (MVPA) (3.2 min, $p = 0.009$, $d = 0.33$). Girls who received no after-school component significantly decreased their MVPA (3.5 min, $p = 0.016$, $d = 0.36$) and increased their ST (17.2 min, $p = 0.006$, $d = 0.43$). The G-PACT intervention demonstrated feasibility of recruitment and data collection procedures for adolescent girls. The peer-led mentoring model shows promise for impacting girls' MVPA levels when combined with an after-school club PA opportunity.

Keywords: adolescents; girls; school; physical activity; sedentary time; intervention; peer-led; mentor; leader; accelerometry